Technical Area: Air Quality
Technical Lead: William Walters

WORKSHOP REQUEST

24. (a) Check the earthmoving equipment (i.e., grader and scraper) mileage, why was 0.1 miles per day per vehicle used?

(b) Explain why unpaved road dust emissions were estimated using South Coast Air Quality Management District (SCAQMD) emission factors instead of using EPA AP-42 emission factors.

(c) Correct Table 4-1 in the Response to CEC Set One Data Request Number 4. Travel on unpaved roads PM10 and PM2.5 emissions are not correct.

(d) Compare the emissions resulting from calculation with SCAQMD and EPA AP-42 fugitive dust emissions factors.

RESPONSE

Fugitive dust emissions from the scrapers and dozers traveling on unpaved road surfaces were calculated using a distance of 0.1 mile, and a distance of 0.5 mile for the graders. This is reasonable because the vast majority of fugitive dust generated from these pieces of equipment will be from the acts of scraping, grading, and dozing, which will occur for 6 hours per day per piece of equipment. For months 1 through 12, daily travel for the scrapers and graders was assumed to be 1.2 and 6 miles, respectively, during earthmoving activities. Scraping and grading activities will only occur in the first year of construction. The fugitive dust calculated from these activities, as opposed to scrapers and dozers traveling on unpaved road surfaces, accounts for nearly all the fugitive dust emissions associated with this equipment. Furthermore, these pieces of equipment would not travel long distances just moving about the site.

In the Revised AFC and the responses to CEC Set One Data Requests Nos. 3, 4, and 57, fugitive dust emissions from travel on unpaved roads were calculated using the emission factors from the South Coast Air Quality Management District (SCAQMD). The SCAQMD factors were used in the Revised AFC analysis because they incorporate the speed of vehicles on the road, and the U.S. Environmental Protection Agency's (U.S. EPA's) AP-42 factors do not. It was believed that the SCAQMD factors would better represent the activity and would reflect the emission reduction from the reduced speed, which is normally used as a mitigation measure.

Fugitive dust emissions from travel on unpaved roads were calculated using the emission factors from the U.S. EPA's AP-42 guidance, in response to the discussion at the April 12, 2010 CEC Workshop, and compared to the emissions using the SCAQMD emission factors. Note that the unpaved roads for the Project Site will be graveled. The resulting emissions are summarized in Revised Tables 3-1, 3-2, 4-1, and 4-2 below. The revised tables summarize the fugitive dust emissions from travel on unpaved roads using AP-42 and SCAQMD factors for comparison purposes. Revised Table 4-1 also presents the corrected emission rates for particulate matter less than or equal to 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$) for travel on unpaved roads.

The emissions are presented below for two short-term and two annual time periods. This was done to ensure that the maximum emissions period was captured. As described in the responses to CEC Set One Data Requests Nos. 3a, 3b, and 3c, the original analysis in the Revised AFC modeled Month 21 as the worst-case short-term period and Months 17 through 28

as the worst-case annual period. With the inclusion of the additional fugitive dust-generating equipment (graders, scrapers, and dozers), it was found that maximum emissions of some pollutants were predicted to occur in Month 1 (short-term) and Months 1 through 12 (annual). Therefore, all periods mentioned above are examined to ensure the maximum emissions were captured. It should be noted that the annual emissions from unpaved roads for both time periods decreased compared to what was previously reported in the responses to Data Requests Nos. 3 and 4 due to an overestimation of the annual vehicle miles traveled.

The tables show that the dust emissions are predicted to be higher when the AP-42 emission factor is used, although, the annual PM_{10} emissions will still be below the General Conformity Rule (GCR) de minimis threshold regardless of which emission factor is used. Note that Revised Table 57-1 presents the construction emissions using the SCAQMD emissions factors. In addition, the modeling analysis showed that PM_{10} emissions, with background included, would exceed ambient air quality standards (AAQS), because the background concentration exceeds the AAQS. To mitigate this, offsets will be surrendered before the construction period. Therefore, it was determined that if the unpaved road emission factor were changed to the U.S. EPA AP-42 factor, the outcome of the analysis would not be changed.

The supporting documentation and calculations for this data response are included as Revised Attachment 3-1, and include the calculations of fugitive dust from all sources, including calculations for travel on unpaved roads based on SCAQMD factors and based on AP-42 factors.

Revised Table 3-1
Total Annual Fugitive Dust from Onsite Equipment – Month 1

Activity	Using SCAQMD Unpaved Road Dust Factors		Using AP-42 Unpaved Road Dust Factors	
	PM_{10} Emissions (lbs/day)	**$PM_{2.5}$ Emissions (lbs/day)**	**PM_{10} Emissions (lbs/day)**	**$PM_{2.5}$ Emissions (lbs/day)**
Grading	0.4362	0.0354	0.4362	0.0354
Bulldozing	51.0596	16.9147	51.0596	16.9147
Dirt Piling	1.0832	0.1640	1.0832	0.1640
Storage Piles	1.6313	0.3393	1.6313	0.3393
Travel on Unpaved Roads	6.7822	1.4378	21.3868	2.4523
Total	**60.99**	**18.89**	**75.60**	**19.91**

Notes:

lbs/day = pounds per day
PM_{10} = particulate matter less than of equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than of equal to 2.5 microns in diameter
SCAQMD = South Coast Air Quality Management District

Revised Table 3-2
Total Annual Fugitive Dust from Onsite Equipment – Months 1-12

Activity	Using SCAQMD Unpaved Road Dust Factors		Using AP-42 Unpaved Road Dust Factors	
	PM_{10} Emissions (tons/year)	$PM_{2.5}$ Emissions (tons/year)	PM_{10} Emissions (tons/year)	$PM_{2.5}$ Emissions (tons/year)
Grading	0.3498	0.0283	0.3498	0.0283
Bulldozing	4.6805	1.5505	4.6805	1.5505
Dirt Piling	0.0357	0.0054	0.0357	0.0054
Storage Piles	0.4763	0.0991	0.4763	0.0991
Travel on Unpaved Roads	1.0898	0.2310	4.2152	0.4215
Total	**6.63**	**1.91**	**9.76**	**2.10**

Notes:

Emissions during Months 1 through 12 include offsite unpaved road dust.

PM_{10} = particulate matter less than of equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than of equal to 2.5 microns in diameter
SCAQMD = South Coast Air Quality Management District

Revised Table 4-1
Total Fugitive Dust from Onsite Equipment – Month 21

Activity	Using SCAQMD Unpaved Road Dust Factors		Using AP-42 Unpaved Road Dust Factors	
	PM_{10} Emissions (lbs/day)	$PM_{2.5}$ Emissions (lbs/day)	PM_{10} Emissions (lbs/day)	$PM_{2.5}$ Emissions (lbs/day)
Dirt Piling	1.2298	0.2558	1.2298	0.2558
Storage Piles	1.6313	0.3393	1.6313	0.3393
Travel on Unpaved Roads	16.6151	3.5224	92.3095	9.2310
Total	**19.48**	**4.12**	**95.17**	**9.83**

Notes:

lbs/day = pounds per day
PM_{10} = particulate matter less than of equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than of equal to 2.5 microns in diameter
SCAQMD = South Coast Air Quality Management District

Revised Table 4-2
Total Annual Fugitive Dust from Onsite Equipment – Months 17 – 28

Activity	Using SCAQMD Unpaved Road Dust Factors		Using AP-42 Unpaved Road Dust Factors	
	PM_{10} Emissions (tons/year)	$PM_{2.5}$ Emissions (tons/year)	PM_{10} Emissions (tons/year)	$PM_{2.5}$ Emissions (tons/year)
Dirt Piling	0.0357	0.0054	0.0357	0.0054
Storage Piles	0.4763	0.0991	0.4763	0.0991
Travel on Unpaved Roads	2.0226	0.4288	11.2573	1.1257
Total	**2.53**	**0.53**	**11.77**	**1.23**

Notes:

PM_{10} = particulate matter less than of equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than of equal to 2.5 microns in diameter
SCAQMD = South Coast Air Quality Management District

REVISED ATTACHMENT 3-1

USING SCAQMD EMISSION FACTORS

Short term fugitive Dust Emissions

Maximum fugitive dust activity occurs in month 1.

1 month of dirt moving
22 construction days per month
10 construction hours per day
60% average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Quantity	Hours/Day	Material Handled (ton/day)	Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Scraper	7	6	38,449	845,875	67%	0.1354	0.8124	0.0205	0.1230
Loader	2	6	10,253	225,567	67%	0.0361	0.2166	0.0055	0.0328
Backhoe	2	6	2,563	56,392	67%	0.0090	0.0542	0.0014	0.0082
				1,127,833	**Total**	**0.1805**	**1.0832**	**0.0273**	**0.1640**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbo
Table 11-4: Mitigation for PM10 Emissions - Construtions.")
assume 75% material handling is done by scrapers, 20% by loaders, and 5% by backhoe

43,445 yd^3/day 51,265 ton/day 2,360 density of soil (lb/yd^3)
955,791 yd^3 1,127,833 tons (USDA NRCS Physical Soil Properties from Kern County for Lockern-Buttonwillow clay)
118.25 acres = 955,791 cubic yds, assume depth of soils moved is 1.67 yd
(assume 25% of entire site in month 1)

Grading Emissions Factor **To be used for all scraping and grading activities**

$E = 0.051(S)^{2.0}$ multiply by 0.60 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
assumed to be 4 mph S = mean vehicle speed (mph) USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

$E = 0.040(S)^{2.5}$ multiply by 0.031 for $PM_{2.5}$
assumed to be 4 mph S = mean vehicle speed (mph)

S = 4.0 mph
1.28 lb ≤ 30 µm/VMT
0.82 lb ≤ 15 µm/VMT
PM_{10} = 0.49 lb PM_{10}/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

Equipment	Quantity	Hours/Day	Daily VMT	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Scraper	7	6	1	67%	0.02	0.11	0.00	0.01
Grader	2	6	2	67%	0.05	0.32	0.00	0.03
				Total	**0.07**	**0.44**	**0.01**	**0.04**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbo
Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")

Bulldozing/Earth clearing

$E = 1.0(s)^{1.5}/(M)^{1.4}$ multiply by 0.75 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 5.7(s)^{1.2}/(M)^{1.3}$ multiply by 0.105 for $PM_{2.5}$ USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1, 11.9-3

50 s = Silt content (%) (from soil boring B-4)
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
4.30 lb/hr of PM10
1.42 lb/hr of PM2.5

Equipment	Quantity	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Dozer	6	6	67%	8.51	51.06	2.82	16.91
			Total	**8.51**	**51.06**	**2.82**	**16.91**

22 construction days per month
1 Total months of soil movement

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbo
Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")

Cover Storage Pile

SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Cover Storage Pile	25	0.25	24	67%	0.07	1.63	0.014	0.339

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbo
Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
pile size and number are assumed

Travel on unpaved roac

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
4 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	No. Of Unit/day	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Concrete Pumper Truck	0			0.0	30	10	0.66	67%	0.00	0.00	0.00	0.00
Dump Truck	3	8	0.75	18.0	15	10	0.41	67%	0.24	2.43	0.05	0.52
Service Truck - 1 ton	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Pile Driver Truck	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Truck - Fuel/Lube	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Tractor Truck 5th Wheel	0			0.0	11	10	0.33	67%	0.00	0.00	0.00	0.00
Trucks - Pickup 3/4 ton	5	10	0.5	25.0	3	4	0.08	67%	0.07	0.69	0.01	0.15
Trucks - 3 ton	0			0.0	11	10	0.33	67%	0.00	0.00	0.00	0.00
Truck - Water	3	4	1	12.0	25	10	0.59	67%	0.23	2.32	0.05	0.49
Air Compressor 185 CFM	0			0.0	0.5	2	0.02	67%	0.00	0.00	0.00	0.00
Air Compressor 750 CFM	1	1	0.01	0.0	0.5	2	0.02	67%	0.00	0.00	0.00	0.00
Articulating Boom Platform	0			0.0	5	10	0.19	67%	0.00	0.00	0.00	0.00
Bulldozer D10R	3	1	0.1	0.3	35	2	0.33	67%	0.00	0.03	0.00	0.01
Bulldozer D4C	3	1	0.1	0.3	15	2	0.18	67%	0.00	0.02	0.00	0.00
Concrete Trowel Machine	0			0.0	15	8	0.37	67%	0.00	0.00	0.00	0.00
Concrete Vibrators	0			0.0	0.25	0	0.00	67%	0.00	0.00	0.00	0.00
Cranes - Mobile 35 ton	0			0.0	25	12	0.64	67%	0.00	0.00	0.00	0.00
Cranes - Mobile 45 ton	0			0.0	35	2	0.33	67%	0.00	0.00	0.00	0.00
Crane - Mobile 65 ton	0			0.0	45	2	0.39	67%	0.00	0.00	0.00	0.00
Cranes 100 / 150 ton cap	0			0.0	50	12	1.04	67%	0.00	0.00	0.00	0.00
Diesel Powered Welder	0			0.0	0.5	2	0.02	67%	0.00	0.00	0.00	0.00
Backhoe/loader	2	4	0.25	2.0	11	4	0.21	67%	0.01	0.14	0.00	0.03
Earth Scraper	7	1	0.1	0.7	40	4	0.51	67%	0.01	0.12	0.00	0.03
Loader	2	2	0.5	2.0	25	4	0.37	67%	0.02	0.24	0.01	0.05
Motor Grader	2	2	0.5	2.0	20	6	0.39	67%	0.03	0.26	0.01	0.05
Excavator - Trencher	0			0.0	17	4	0.28	67%	0.00	0.00	0.00	0.00
Fired Heaters	0			0.0	0.25	0	0.00	67%	0.00	0.00	0.00	0.00
Forklift	0			0.0	10	4	0.19	67%	0.00	0.00	0.00	0.00
Fusion Welder	0			0.0	0.25	2	0.01	67%	0.00	0.00	0.00	0.00
Heavy Haul / Cranes	0			0.0	75	2	0.56	67%	0.00	0.00	0.00	0.00
Light Plants	0			0.0	0.5	4	0.02	67%	0.00	0.00	0.00	0.00
Portable Compaction Roller	0			0.0	3	3	0.07	67%	0.00	0.00	0.00	0.00
Portable Compaction - Plate	0			0.0	0.1	0	0.00	67%	0.00	0.00	0.00	0.00
Portable Compaction - Ram	0			0.0	0.25	0	0.00	67%	0.00	0.00	0.00	0.00
Pumps	3	0	0	0.0	0.1	0	0.00	67%	0.00	0.00	0.00	0.00
Portable Power Generators	0			0.0	0.5	4	0.02	67%	0.00	0.00	0.00	0.00
Truck Crane - Greater than 200 ton	0			0.0	50	12	1.04	67%	0.00	0.00	0.00	0.00
Truck Crane - Greater than 300 ton	0			0.0	60	12	1.18	67%	0.00	0.00	0.00	0.00
Vibratory Roller 20 ton	3	1	0.25	0.8	20	3	0.27	67%	0.01	0.07	0.00	0.01
worker personal vehicles	34	1	0.5	16.9	3	4	0.08	67%	0.05	0.47	0.01	0.10
								Total	**0.68**	**6.78**	**0.14**	**1.44**

Assumed maximum travel speed is 4 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbo
Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.

10 Maximum number of construction work hours per day

CEQA Load Factors (Table A9-8-D)						average equipment load factor
generator	74	crane	43	roller	57.5	58
welder	45	pumps	74	loader	54	
compressors	48	light plant	62	backhoe	46.5	
crawler dozer	59	trucks	57	grader	57.5	
drill rig	75	forklift	47.5	scraper	66	

Total Annual Fugitive Dust from Onsite Equipment - Month 1

	PM_{10} Emissions (lbs/day)	$PM_{2.5}$ Emissions (lbs/day)
Grading	0.4362	0.0354
Bulldozing	51.0596	16.9147
Dirt Piling	1.0832	0.1640
Storage Piles	1.6313	0.3393
Travel on Unpaved Roads	6.7822	1.4378
TOTAL	**60.99**	**18.89**

Annual Fugitive Dust Emissions

Maximum annual fugitive dust activity occurs in months 1-12.

7 months of soil disturbance
10 total construction hours per work day
22 construction days per month
60% average load factor for equipment listed (CEQA)

Grading Emissions Factor **To be used for all scraping and grading activities (except material handling)**

$E = 0.051(S)^{2.0}$ multiply by 0.60 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
assumed to be 4 mph S = mean vehicle speed (mph) USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

$E = 0.040(S)^{2.5}$ multiply by 0.031 for $PM_{2.5}$
assumed to be 4 mph S = mean vehicle speed (mph)

S = 4.0 mph
1.28 lb ≤ 30 µm/VMT
0.82 lb ≤ 15 µm/VMT
PM_{10} = 0.49 lb PM_{10}/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

Equipment	Quantity	Hours/Day	Annual VMT	Watering Control Efficiency	PM10 Emissions (lb/yr)	PM10 Emissions (ton/yr)	PM2.5 Emissions (lb/yr)	PM2.5 Emissions (ton/yr)
Scraper	24	6	634	67%	102	0.05	8.3	0.00
Grader	14	6	3,696	67%	597	0.30	48.4	0.02
				Total	**700**	**0.35**	**56.7**	**0.03**

Bulldozing/Earth clearing

$E = 1.0(s)^{1.2}/(M)^{1.4}$ multiply by 0.75 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 5.7(s)^{1.2}/(M)^{1.3}$ multiply by 0.105 for $PM_{2.5}$ USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1, 11.9-3

50 s = Silt content (%) (from soil boring B-4)
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
4.30 lb/hr of PM_{10}
1.42 lb/hr of $PM_{2.5}$

Equipment	Quantity	Hours/Day	Watering Control Efficiency	PM10 Emissions (ton/yr)	PM2.5 Emissions (ton/yr)
Dozer	50	6	67%	4.68	1.55
			Total	**4.68**	**1.55**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Scraper	1,691,750	67%	0.0179	0.0027
Loader	1,522,575	67%	0.0161	0.0024
Backhoe	169,175	67%	0.0018	0.0003
	3,383,500	**Total**	**0.0357**	**0.0054**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
assume scraper handles 50% of dirt, loader 45%, and backhoe 5%

18,619 yd^3/day 21,971 ton/day 2360 density of soil (lb/yd^3)
2,867,373 yd^3 3,383,500 tons (USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
354.75 acres = 2,867,373 cubic yds, assume depth of soils moved is 1.67 yd
(assume 75% of entire site disturbed in 12 month period)

Cover Storage Pile

SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	40	0.25	365	67%	0.48	0.099

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
4 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Concrete Pumper Truck	6	2	0.75	198.0	30	10	0.66	67%	0.022	0.005
Dump Truck	32	8	0.75	4224.0	15	10	0.41	67%	0.285	0.060
Service Truck - 1 ton	0			0.0	15	10	0.41	67%	0.000	0.000
Pile Driver Truck	12	2	0.1	52.8	15	10	0.41	67%	0.004	0.001
Truck - Fuel/Lube	0			0.0	15	10	0.41	67%	0.000	0.000
Tractor Truck 5th Wheel	0			0.0	11	10	0.33	67%	0.000	0.000
Trucks - Pickup 3/4 ton	60	10	0.5	6600.0	3	4	0.08	67%	0.091	0.019
Trucks - 3 ton	15	2	0.5	330.0	11	10	0.33	67%	0.018	0.004
Truck - Water	28	4	1	2464.0	25	10	0.59	67%	0.238	0.050
Air Compressor 185 CFM	0			0.0	0.5	2	0.02	67%	0.000	0.000
Air Compressor 750 CFM	16	1	0.01	3.5	0.5	2	0.02	67%	0.000	0.000
Articulating Boom Platform	0			0.0	5	10	0.19	67%	0.000	0.000
Bulldozer D10R	24	1	0.1	52.8	35	2	0.33	67%	0.003	0.001
Bulldozer D4C	26	1	0.1	57.2	15	2	0.18	67%	0.002	0.000
Concrete Trowel Machine	8	1	0.25	44.0	15	8	0.37	67%	0.003	0.001
Concrete Vibrators	0			0.0	0.25	0	0.00	67%	0.000	0.000
Cranes - Mobile 35 ton	15	1	0.1	33.0	25	12	0.64	67%	0.003	0.001
Cranes - Mobile 45 ton	0			0.0	35	2	0.33	67%	0.000	0.000
Crane - Mobile 65 ton	0			0.0	45	2	0.39	67%	0.000	0.000
Cranes 100 / 150 ton cap	2	0	0	0.0	50	12	1.04	67%	0.000	0.000
Diesel Powered Welder	8	0	0	0.0	0.5	2	0.02	67%	0.000	0.000
Backhoe/loader	40	4	0.25	880.0	11	4	0.21	67%	0.030	0.006
Earth Scraper	24	1	0.1	52.8	40	4	0.51	67%	0.004	0.001
Loader	24	2	0.5	528.0	25	4	0.37	67%	0.032	0.007
Motor Grader	14	2	0.5	308.0	20	6	0.39	67%	0.020	0.004
Excavator - Trencher	0			0.0	17	4	0.28	67%	0.000	0.000
Fired Heaters	24	0	0	0.0	0.25	0	0.00	67%	0.000	0.000
Forklift	7	5	0.5	385.0	10	4	0.19	67%	0.012	0.003
Fusion Welder	0			0.0	0.25	2	0.01	67%	0.000	0.000
Heavy Haul / Cranes	0			0.0	75	2	0.56	67%	0.000	0.000
Light Plants	18	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Portable Compaction Roller	19	0	0	0.0	3	3	0.07	67%	0.000	0.000
Portable Compaction - Plate	15	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Compaction - Ram	0			0.0	0.25	0	0.00	67%	0.000	0.000
Pumps	35	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Power Generators	19	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Truck Crane - Greater than 200 ton	1	1	0.1	2.2	50	12	1.04	67%	0.000	0.000
Truck Crane - Greater than 300 ton	0			0.0	60	12	1.18	67%	0.000	0.000
Vibratory Roller 20 ton	27	2	0.25	297.0	20	3	0.27	67%	0.013	0.003
worker personal vehicles	2028	1	0.5	22304.6	3	4	0.08	67%	0.309	0.065
								Total	**1.090**	**0.231**

worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, total for months 1-12 divided by 1.3 employees per vehicle

Assumed maximum travel speed is 4 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
except for worker vehicles - parking area will be graveled and main road onsite will be paved
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.

Total Annual Fugitive Dust from Onsite Equipment - Months 1 - 12

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Grading	0.3498	0.0283
Bulldozing	4.6805	1.5505
Dirt Piling	0.0357	0.0054
Storage Piles	0.4763	0.0991
Travel on Unpaved Roads	1.0898	0.2310
TOTAL	**6.63**	**1.91**

Short term fugitive Dust Emissions

Maximum construction activity occurs in month 21.

1 month of dirt moving
22 construction days per month
10 construction hours per day
60% average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Quantity	Hours/Day	Material Handled (ton/day)	Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Backhoe	1	6	58202	1,280,437	67%	0.2050	1.2298	0.0426	0.2558
					Total	**0.2050**	**1.2298**	**0.0426**	**0.2558**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")

49323 yd^3/day 58202 ton/day
1,085,116 yd^3 1,280,437 tons 2360 density of soil (lb/yd^3)
(USDA NRCS Physical Soil Properties from Kern County for Lockern-Buttonwillow clay)
134.25 acres = 1,085,116 cubic yds, assume depth of soils moved is 1.67 yd
(assume 25% of entire site in month 21)

Cover Storage Pile

SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from onsite soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Cover Storage Pile	25	0.25	24	67%	0.07	1.63	0.014	0.339

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")
pile size and number are assumed

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
4 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	No. Of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Concrete Pumper Truck	1	2	0.75	1.5	30	10	0.66	67%	0.03	0.33	0.01	0.07
Dump Truck	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Service Truck - 1 ton	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Pile Driver Truck	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Truck - Fuel/Lube	0			0.0	15	10	0.41	67%	0.00	0.00	0.00	0.00
Tractor Truck 5th Wheel	0			0.0	11	10	0.33	67%	0.00	0.00	0.00	0.00
Trucks - Pickup 3/4 ton	5	10	0.5	25.0	3	4	0.08	67%	0.07	0.69	0.01	0.15
Trucks - 3 ton	2	2	0.5	2.0	11	10	0.33	67%	0.02	0.22	0.00	0.05
Truck - Water	1	4	1	4.0	25	10	0.59	67%	0.08	0.77	0.02	0.16
Air Compressor 185 CFM	0			0.0	0.5	2	0.02	67%	0.00	0.00	0.00	0.00
Air Compressor 750 CFM	4	1	0.01	0.0	0.5	2	0.02	67%	0.00	0.00	0.00	0.00
Articulating Boom Platform	0			0.0	5	10	0.19	67%	0.00	0.00	0.00	0.00
Bulldozer D10R	0			0.0	35	2	0.33	67%	0.00	0.00	0.00	0.00
Bulldozer D4C	0			0.0	15	2	0.18	67%	0.00	0.00	0.00	0.00
Concrete Trowel Machine	0			0.0	15	8	0.37	67%	0.00	0.00	0.00	0.00
Concrete Vibrators	0			0.0	0.25	0	0.00	67%	0.00	0.00	0.00	0.00
Cranes - Mobile 35 ton	7	1	0.1	0.7	25	12	0.64	67%	0.01	0.15	0.00	0.03
Cranes - Mobile 45 ton	0			0.0	35	2	0.33	67%	0.00	0.00	0.00	0.00
Crane - Mobile 65 ton	6	1	0.1	0.6	45	2	0.39	67%	0.01	0.08	0.00	0.02
Cranes 100 / 150 ton cap	4	0	0	0.0	50	12	1.04	67%	0.00	0.00	0.00	0.00
Diesel Powered Welder	3	0	0	0.0	0.5	2	0.02	67%	0.00	0.00	0.00	0.00
Backhoe/loader	1	4	0.25	1.0	11	4	0.21	67%	0.01	0.07	0.00	0.01
Earth Scraper	0			0.0	40	4	0.51	67%	0.00	0.00	0.00	0.00
Loader	0			0.0	25	4	0.37	67%	0.00	0.00	0.00	0.00
Motor Grader	0			0.0	20	6	0.39	67%	0.00	0.00	0.00	0.00
Excavator - Trencher	0			0.0	17	4	0.28	67%	0.00	0.00	0.00	0.00
Fired Heaters	5	0	0	0.0	0.25	0	0.00	67%	0.00	0.00	0.00	0.00
Forklift	3	5	0.5	7.5	10	4	0.19	67%	0.05	0.48	0.01	0.10
Fusion Welder	0			0.0	0.25	2	0.01	67%	0.00	0.00	0.00	0.00
Heavy Haul / Cranes	5	0	0	0.0	75	2	0.56	67%	0.00	0.00	0.00	0.00
Light Plants	6	0	0	0.0	0.5	4	0.02	67%	0.00	0.00	0.00	0.00
Portable Compaction Roller	2	0	0	0.0	3	3	0.07	67%	0.00	0.00	0.00	0.00
Portable Compaction - Plate	3	0	0	0.0	0.1	0	0.00	67%	0.00	0.00	0.00	0.00
Portable Compaction - Ram	0			0.0	0.25	0	0.00	67%	0.00	0.00	0.00	0.00
Pumps	2	0	0	0.0	0.1	0	0.00	67%	0.00	0.00	0.00	0.00
Portable Power Generators	5	0	0	0.0	0.5	4	0.02	67%	0.00	0.00	0.00	0.00
Truck Crane - Greater than 200 ton	4	1	0.1	0.4	50	12	1.04	67%	0.01	0.14	0.00	0.03
Truck Crane - Greater than 300 ton	2	0	0	0.0	60	12	1.18	67%	0.00	0.00	0.00	0.00
Vibratory Roller 20 ton	0			0.0	20	3	0.27	67%	0.00	0.00	0.00	0.00
worker personal vehicles	989	1	0.5	494.6	3	4	0.08	67%	1.37	13.69	0.29	2.90
								Total	**1.66**	**16.62**	**0.35**	**3.52**

Assumed maximum travel speed is 4 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.
10 Maximum number of construction work hours per day

CEQA Load Factors (Table A9-8-D)

						average equipment load factor
generator	74	crane	43	roller	57.5	58
welder	45	pumps	74	loader	54	
compressors	48	light plant	62	backhoe	46.5	
crawler dozer	59	trucks	57	grader	57.5	
drill rig	75	forklift	47.5	scraper	66	

Total Fugitive Dust from Onsite Equipment - Month 21

	PM_{10} Emissions (lb/day)	$PM_{2.5}$ Emissions (lb/day)
Dirt Piling	1.2298	0.2558
Storage Piles	1.6313	0.3393
Travel on Unpaved Roads	16.6151	3.5224
TOTAL	**19.48**	**4.12**

Annual Fugitive Dust Emissions

Maximum annual fugitive dust activity occurs in months 17-28.

7 months of soil disturbance
10 total construction hours per work day
22 construction days per month
60% average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Scraper	1,691,750	67%	0.018	0.003
Loader	1,522,575	67%	0.016	0.002
Backhoe	169,175	67%	0.002	0.000
	3,383,500	**Total**	**0.036**	**0.005**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
assume scraper handles 50% of dirt, loader 45%, and backhoe 5%

18,619 yd^3/day 21,971 ton/day 2360 density of soil (lb/yd^3)
2,867,373 yd^3 3,383,500 tons (USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
354.75 acres = 2,867,373 cubic yds, assume depth of soils moved is 1.67 yd
(assume 75% of entire site in 12 month period)

Cover Storage Pile

SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM10 = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	40	0.25	365	67%	0.48	0.099

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
4 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Concrete Pumper Truck	6	2	0.75	198.0	30	10	0.66	67%	0.022	0.005
Dump Truck	0			0.0	15	10	0.41	67%	0.000	0.000
Service Truck - 1 ton	0			0.0	15	10	0.41	67%	0.000	0.000
Pile Driver Truck	0			0.0	15	10	0.41	67%	0.000	0.000
Truck - Fuel/Lube	0			0.0	15	10	0.41	67%	0.000	0.000
Tractor Truck 5th Wheel	0			0.0	11	10	0.33	67%	0.000	0.000
Trucks - Pickup 3/4 ton	60	10	0.5	6600.0	3	4	0.08	67%	0.091	0.019
Trucks - 3 ton	24	2	0.5	528.0	11	10	0.33	67%	0.029	0.006
Truck - Water	12	4	1	1056.0	25	10	0.59	67%	0.102	0.022
Air Compressor 185 CFM	0			0.0	0.5	2	0.02	67%	0.000	0.000
Air Compressor 750 CFM	48	1	0.01	10.6	0.5	2	0.02	67%	0.000	0.000
Articulating Boom Platform	0			0.0	5	10	0.19	67%	0.000	0.000
Bulldozer D10R	0			0.0	35	2	0.33	67%	0.000	0.000
Bulldozer D4C	0			0.0	15	2	0.18	67%	0.000	0.000
Concrete Trowel Machine	12	1	0.25	66.0	15	8	0.37	67%	0.004	0.001
Concrete Vibrators	0			0.0	0.25	0	0.00	67%	0.000	0.000
Cranes - Mobile 35 ton	80	1	0.1	176.0	25	12	0.64	67%	0.019	0.004
Cranes - Mobile 45 ton	0			0.0	35	2	0.33	67%	0.000	0.000
Crane - Mobile 65 ton	70	1	0.1	154.0	45	2	0.39	67%	0.010	0.002
Cranes 100 / 150 ton cap	48	0	0	0.0	50	12	1.04	67%	0.000	0.000
Diesel Powered Welder	41	0	0	0.0	0.5	2	0.02	67%	0.000	0.000
Backhoe/loader	6	4	0.25	132.0	11	4	0.21	67%	0.005	0.001
Earth Scraper	0			0.0	40	4	0.51	67%	0.000	0.000
Loader	0			0.0	25	4	0.37	67%	0.000	0.000
Motor Grader	0			0.0	20	6	0.39	67%	0.000	0.000
Excavator - Trencher	0			0.0	17	4	0.28	67%	0.000	0.000
Fired Heaters	53	0	0	0.0	0.25	0	0.00	67%	0.000	0.000
Forklift	36	5	0.5	1980.0	10	4	0.19	67%	0.064	0.013
Fusion Welder	0			0.0	0.25	2	0.01	67%	0.000	0.000
Heavy Haul / Cranes	32	0	0	0.0	75	2	0.56	67%	0.000	0.000
Light Plants	84	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Portable Compaction Roller	10	0	0	0.0	3	3	0.07	67%	0.000	0.000
Portable Compaction - Plate	18	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Compaction - Ram	0			0.0	0.25	0	0.00	67%	0.000	0.000
Pumps	24	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Power Generators	60	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Truck Crane - Greater than 200 ton	42	1	0.1	92.4	50	12	1.04	67%	0.016	0.003
Truck Crane - Greater than 300 ton	27	0	0	0.0	60	12	1.18	67%	0.000	0.000
Vibratory Roller 20 ton	0			0.0	20	3	0.27	67%	0.000	0.000
worker personal vehicles	10919	1	0.5	120111.5	3	4	0.08	67%	1.662	0.352
								Total	**2.023**	**0.429**

worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, total for months 17-28 divided by 1.3 employees per vehicle

Assumed maximum travel speed is 4 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
except for worker vehicles - parking area will be graveled and main road onsite will be paved
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.

Total Annual Fugitive Dust from Onsite Equipment - Months 17 - 28

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Dirt Piling	0.0357	0.0054
Storage Piles	0.4763	0.0991
Travel on Unpaved Roads	2.0226	0.4288
TOTAL	**2.53**	**0.53**

Annual Off-Site Linears Fugitive Dust Emissions — Emissions Summary

Hydrogen Energy, Inc *5/12/2010*
HECA Project

Annual Fugitive Dust Emissions for Offsite Linears
Maximum annual fugitive dust activity occurs in months 1-12.

12 months of soil disturbance
10 total construction hours per work day
22 construction days per month

Dirt Piling or Material Handling
$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$ PM_{10} Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

12 G = Mean Wind speed (mph) default
15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)
0.00021 lb of PM_{10}/ ton of material

Equipment	Quantity/ year	Hours/ Day	Annual Material Handled (ton)	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Backhoe	12	10	1,102,262	67%	0.0379	0.0079
				Total	**0.0379**	**0.0079**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM10 Emissions - Constrution.")

3538 yd^3/day 4175 ton/day
934,120 yd^3 1,102,262 tons 2360 density of soil (lb/yd^3)
(USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
193 acres = 934,120 cubic yds, assume depth of soils moved is 1 yd

Storage Piles
SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from Geotechnical Investigaion, AFC Appendix P)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Storage Piles	8	0.25	365	67%	0.10	0.020

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road
$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
5 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance on Dirt Surface (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM_{10} EF (lbs/VMT)	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
ON ROAD										
Dump Truck	12	4	0.25	264.0	17	10	0.56	67%	0.0243	0.0052
Service Truck (MHD-DSL)	0	1	0.125	0.0	4	6	0.16	67%	0.0000	0.0000
Pipe Haul Truck and Trailer (HHDT-DSL	12			0.0	15	10	0.51	67%	0.0000	0.0000
Truck (Pickup 3/4 Ton) - MHD-DSL	17	2	0.25	187.0	1	4	0.05	67%	0.0015	0.0003
Truck - water	12	4	0.25	264.0	25	10	0.73	67%	0.0319	0.0068
OFF ROAD										
Air Compressor	10					4	0.00	67%	0.0000	0.0000
Bore Machine (Hydraulic)	5					10	0.00	67%	0.0000	0.0000
Crane	5					10	0.00	67%	0.0000	0.0000
Backhoe	12					2	0.00	67%	0.0000	0.0000
Excavator	12	1	0.25	66.0	17	4	0.35	67%	0.0038	0.0008
Forklift	4	4	0.25	88.0	10	4	0.24	67%	0.0035	0.0007
Welding Generator	4					3	0.00	67%	0.0000	0.0000
Roller	12	4	0.25	264.0	20	3	0.34	67%	0.0149	0.0032
Pipe Bending Machine	12						0.00	67%	0.0000	0.0000
worker personal vehicles	2028	1	0.125	5576.2	3	4	0.10	67%	0.0965	0.0204
								Total	**0.1764**	**0.0374**

offsite worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, total for months 1-12 divided by 1.3 employees per vehicle

Assumed maximum travel speed is 5 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")
except for worker vehicles - parking area will be graveled and main road onsite will be paved
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.
Truck quantity based on monthly maximums

Total Annual Fugitive Dust from Offsite Linears Construction

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Dirt Piling or Material Handling	0.0379	0.0079
Storage Piles	0.0953	0.0198
Travel on unpaved road	0.1764	0.0374
TOTAL	**0.3096**	**0.0651**

USING EPA AP-42 EMISSION FACTORS

Short term fugitive Dust Emissions

Maximum fugitive dust activity occurs in month 1.

1 month of dirt moving
22 construction days per month
10 construction hours per day
60% average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Quantity	Hours/Day	Material Handled (ton/day)	Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Scraper	7	6	38,449	845,875	67%	0.1354	0.8124	0.0205	0.1230
Loader	2	6	10,253	225,567	67%	0.0361	0.2166	0.0055	0.0328
Backhoe	2	6	2,563	56,392	67%	0.0090	0.0542	0.0014	0.0082
				1,127,833	**Total**	**0.1805**	**1.0832**	**0.0273**	**0.1640**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
assume 75% material handling is done by scrapers, 20% by loaders, and 5% by backhoe

43,445 yd^3/day 51,265 ton/day 2,360 density of soil (lb/yd^3)
955,791 yd^3 1,127,833 tons (USDA NRCS Physical Soil Properties from Kern County for Lockern-Buttonwillow clay)
118.25 acres = 955,791 cubic yds, assume depth of soils moved is 1.67 yd
(assume 25% of entire site in month 1)

Grading Emissions Factor **To be used for all scraping and grading activities**

$E = 0.051(S)^{2.0}$ multiply by 0.60 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
assumed to be 4 mph S = mean vehicle speed (mph) USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

$E = 0.040(S)^{2.5}$ multiply by 0.031 for $PM_{2.5}$
assumed to be 4 mph S = mean vehicle speed (mph)

S = 4.0 mph
1.28 lb ≤ 30 µm/VMT
0.82 lb ≤ 15 µm/VMT
PM_{10} = 0.49 lb PM_{10}/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

Equipment	Quantity	Hours/Day	Daily VMT	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Scraper	7	6	1	67%	0.02	0.11	0.00	0.01
Grader	2	6	2	67%	0.05	0.32	0.00	0.03
				Total	**0.07**	**0.44**	**0.01**	**0.04**

Bulldozing/Earth clearing

$E = 1.0(s)^{1.5}/(M)^{1.4}$ multiply by 0.75 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
multiply by 0.105 for $PM_{2.5}$ USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1, 11.9-3

50 s = Silt content (%) (from soil boring B-4)
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
4.30 lb/hr of PM_{10}
1.42 lb/hr of $PM_{2.5}$

Equipment	Quantity	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Dozer	6	6	67%	8.51	51.06	2.82	16.91
			Total	**8.51**	**51.06**	**2.82**	**16.91**

22 construction days per month
1 Total months of soil movement

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

Cover Storage Pile

SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Cover Storage Pile	25	0.25	24	67%	0.07	1.63	0.014	0.339

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size and number are assumed

Travel on unpaved road

$E = k (s/12)^a (w/3)^b$ Entrained dust estimates calculated using guidance from AP 42, Fifth Edition, Volume I Chapter 13.2.2: Unpaved Roads
$E_{ext} = E ((365-P)/365)$
Emission factor for vehicle travel on unpaved roads (lb/VMT)

E = size-specific emission factor (lb/VMT)
4.00 s = surface material silt content (%) - Gravel Road
W = mean vehicle weight (tons)
E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
37 P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation (from WRCC for Bakersfield Airport Station)

Constant for Industrial Roads

	PM-2.5	PM-10
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Vehicle Type	No. Of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 EF (lbs/VMT)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Concrete Pumper Truck	0			0.0	30	10	1.41	67%	0.00	0.00	0.14	0.00	0.00
Dump Truck	3	8	0.75	18.0	15	10	1.03	67%	0.61	6.15	0.10	0.06	0.61
Service Truck - 1 ton	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Pile Driver Truck	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Truck - Fuel/Lube	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Tractor Truck 5th Wheel	0			0.0	11	10	0.90	67%	0.00	0.00	0.09	0.00	0.00
Trucks - Pickup 3/4 ton	5	10	0.5	25.0	3	4	0.50	67%	0.41	4.14	0.05	0.04	0.41
Trucks - 3 ton	0			0.0	11	10	0.90	67%	0.00	0.00	0.09	0.00	0.00
Truck - Water	3	4	1	12.0	25	10	1.30	67%	0.52	5.16	0.13	0.05	0.52
Air Compressor 185 CFM	0			0.0	0.5	2	0.22	67%	0.00	0.00	0.02	0.00	0.00
Air Compressor 750 CFM	1	1	0.01	0.0	0.5	2	0.22	67%	0.00	0.00	0.02	0.00	0.00
Articulating Boom Platform	0			0.0	5	10	0.63	67%	0.00	0.00	0.06	0.00	0.00
Bulldozer D10R	3	1	0.1	0.3	35	2	1.51	67%	0.01	0.15	0.15	0.00	0.01
Bulldozer D4C	3	1	0.1	0.3	15	2	1.03	67%	0.01	0.10	0.10	0.00	0.01
Concrete Trowel Machine	0			0.0	15	8	1.03	67%	0.00	0.00	0.10	0.00	0.00
Concrete Vibrators	0			0.0	0.25	0	0.16	67%	0.00	0.00	0.02	0.00	0.00
Cranes - Mobile 35 ton	0			0.0	25	12	1.30	67%	0.00	0.00	0.13	0.00	0.00
Cranes - Mobile 45 ton	0			0.0	35	2	1.51	67%	0.00	0.00	0.15	0.00	0.00
Crane - Mobile 65 ton	0			0.0	45	2	1.70	67%	0.00	0.00	0.17	0.00	0.00
Cranes 100 / 150 ton cap	0			0.0	50	12	1.78	67%	0.00	0.00	0.18	0.00	0.00
Diesel Powered Welder	0			0.0	0.5	2	0.22	67%	0.00	0.00	0.02	0.00	0.00
Backhoe/loader	2	4	0.25	2.0	11	4	0.90	67%	0.06	0.59	0.09	0.01	0.06
Earth Scraper	7	1	0.1	0.7	40	4	1.61	67%	0.04	0.37	0.16	0.00	0.04
Loader	2	2	0.5	2.0	25	4	1.30	67%	0.09	0.86	0.13	0.01	0.09
Motor Grader	2	2	0.5	2.0	20	6	1.18	67%	0.08	0.78	0.12	0.01	0.08
Excavator - Trencher	0			0.0	17	4	1.09	67%	0.00	0.00	0.11	0.00	0.00
Fired Heaters	0			0.0	0.25	0	0.16	67%	0.00	0.00	0.02	0.00	0.00
Forklift	0			0.0	10	4	0.86	67%	0.00	0.00	0.09	0.00	0.00
Fusion Welder	0			0.0	0.25	2	0.16	67%	0.00	0.00	0.02	0.00	0.00
Heavy Haul / Cranes	0			0.0	75	2	2.13	67%	0.00	0.00	0.21	0.00	0.00
Light Plants	0			0.0	0.5	4	0.22	67%	0.00	0.00	0.02	0.00	0.00
Portable Compaction Roller	0			0.0	3	3	0.50	67%	0.00	0.00	0.05	0.00	0.00
Portable Compaction - Plate	0			0.0	0.1	0	0.11	67%	0.00	0.00	0.01	0.00	0.00
Portable Compaction - Ram	0			0.0	0.25	0	0.16	67%	0.00	0.00	0.02	0.00	0.00
Pumps	3	0	0	0.0	0.1	0	0.11	67%	0.00	0.00	0.01	0.00	0.00
Portable Power Generators	0			0.0	0.5	4	0.22	67%	0.00	0.00	0.02	0.00	0.00
Truck Crane - Greater than 200 ton	0			0.0	50	12	1.78	67%	0.00	0.00	0.18	0.00	0.00
Truck Crane - Greater than 300 ton	0			0.0	60	12	1.93	67%	0.00	0.00	0.19	0.00	0.00
Vibratory Roller 20 ton	3	1	0.25	0.8	20	3	1.18	67%	0.03	0.29	0.12	0.00	0.03
								Total	**2.14**	**21.39**		**0.25**	**2.45**
Worker personal vehicles	34	1	0.5	16.9	3	4	0.50	67%	0.28	2.80	0.05	0.06	0.59

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants. Parking area will be graveled and main onsite road will be paved.
Water trucks operate at least 4 times per day.
10 Maximum number of construction work hours per day

Total Annual Fugitive Dust from Onsite Equipment - Month 1

	PM_{10} Emissions (lbs/day)	$PM_{2.5}$ Emissions (lbs/day)
Grading	0.4362	0.0354
Bulldozing	51.0596	16.9147
Dirt Piling	1.0832	0.1640
Storage Piles	1.6313	0.3393
Travel on Unpaved Roads	21.3868	2.4523
TOTAL	**75.60**	**19.91**

Annual Fugitive Dust Emissions

Maximum annual fugitive dust activity occurs in months 1-12.

7 months of soil disturbance
10 total construction hours per work day
22 construction days per month
60% average load factor for equipment listed (CEQA)

Grading Emissions Factor **To be used for all scraping and grading activities (except material handling**

$E = 0.051(S)^{2.0}$ multiply by 0.60 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
assumed to be 4 mph S = mean vehicle speed (mph) USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

$E = 0.040(S)^{2.5}$ multiply by 0.031 for $PM_{2.5}$
assumed to be 4 mph S = mean vehicle speed (mph)

S = 4.0 mph
1.28 lb ≤ 30 µm/VMT
0.82 lb ≤ 15 µm/VMT
PM_{10} = 0.49 lb PM_{10}/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

Equipment	Quantity	Hours/Day	Annual VMT	Watering Control Efficiency	PM10 Emissions (lb/yr)	PM10 Emissions (ton/yr)	PM2.5 Emissions (lb/yr)	PM2.5 Emissions (ton/yr)
Scraper	24	6	634	67%	102	0.05	8.3	0.00
Grader	14	6	3,696	67%	597	0.30	48.4	0.02
				Total	**700**	**0.35**	**56.7**	**0.03**

Bulldozing/Earth clearing

$E = 1.0(s)^{1.5}/(M)^{1.4}$ multiply by 0.75 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 5.7(s)^{1.2}/(M)^{1.3}$ multiply by 0.105 for $PM_{2.5}$ USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1, 11.9-3

50 s = Silt content (%) (from soil boring B-4)
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
4.30 lb/hr of PM_{10}
1.42 lb/hr of $PM_{2.5}$

Equipment	Quantity	Hours/Day	Watering Control Efficiency	PM10 Emissions (ton/yr)	PM2.5 Emissions (ton/yr)
Dozer	50	6	67%	4.68	1.55
			Total	**4.68**	**1.55**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Scraper	1,691,750	67%	0.0179	0.0027
Loader	1,522,575	67%	0.0161	0.0024
Backhoe	169,175	67%	0.0018	0.0003
	3,383,500	**Total**	**0.0357**	**0.0054**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
assume scraper handles 50% of dirt, loader 45%, and backhoe 5%

18,619 yd^3/day 21,971 ton/day 2360 density of soil (lb/yd^3)
2,867,373 yd^3 3,383,500 tons (USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
354.75 acres = 2,867,373 cubic yds, assume depth of soils moved is 1.67 yd
(assume 75% of entire site disturbed in 12 month period)

Cover Storage Pile

SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	40	0.25	365	67%	0.48	0.099

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved roac

$E = k (s/12)^a (w/3)^b$ Entrained dust estimates calculated using guidance from AP 42, Fifth Edition, Volume I Chapter 13.2.2: Unpaved Roads
$E_{ext} = E ((365-P)/365)$
Emission factor for vehicle travel on unpaved roads (lb/VMT)

E = size-specific emission factor (lb/VMT)
4.00 s = surface material silt content (%) - Gravel Road
W = mean vehicle weight (tons)
E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
37 P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation (from WRCC for Bakersfield Airport Station)

Constant for Industrial Roads

	PM-2.5	PM-10
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 EF (lbs/VMT)	PM2.5 Emissions (tons/yr)
Concrete Pumper Truck	6	2	0.75	198.0	30	10	1.41	67%	0.046	0.14	0.00
Dump Truck	32	8	0.75	4224.0	15	10	1.03	67%	0.721	0.10	0.07
Service Truck - 1 ton	0			0.0	15	10	1.03	67%	0.000	0.10	0.00
Pile Driver Truck	12	2	0.1	52.8	15	10	1.03	67%	0.009	0.10	0.00
Truck - Fuel/Lube	0			0.0	15	10	1.03	67%	0.000	0.10	0.00
Tractor Truck 5th Wheel	0			0.0	11	10	0.90	67%	0.000	0.09	0.00
Trucks - Pickup 3/4 ton	60	10	0.5	6600.0	3	4	0.50	67%	0.546	0.05	0.05
Trucks - 3 ton	15	2	0.5	330.0	11	10	0.90	67%	0.049	0.09	0.00
Truck - Water	28	4	1	2464.0	25	10	1.30	67%	0.529	0.13	0.05
Air Compressor 185 CFM	0			0.0	0.5	2	0.22	67%	0.000	0.02	0.00
Air Compressor 750 CFM	16	1	0.01	3.5	0.5	2	0.22	67%	0.000	0.02	0.00
Articulating Boom Platform	0			0.0	5	10	0.63	67%	0.000	0.06	0.00
Bulldozer D10R	24	1	0.1	52.8	35	2	1.51	67%	0.013	0.15	0.00
Bulldozer D4C	26	1	0.1	57.2	15	2	1.03	67%	0.010	0.10	0.00
Concrete Trowel Machine	8	1	0.25	44.0	15	8	1.03	67%	0.008	0.10	0.00
Concrete Vibrators	0			0.0	0.25	0	0.16	67%	0.000	0.02	0.00
Cranes - Mobile 35 ton	15	1	0.1	33.0	25	12	1.30	67%	0.007	0.13	0.00
Cranes - Mobile 45 ton	0			0.0	35	2	1.51	67%	0.000	0.15	0.00
Crane - Mobile 65 ton	0			0.0	45	2	1.70	67%	0.000	0.17	0.00
Cranes 100 / 150 ton cap	2	0	0	0.0	50	12	1.78	67%	0.000	0.18	0.00
Diesel Powered Welder	8	0	0	0.0	0.5	2	0.22	67%	0.000	0.02	0.00
Backhoe/loader	40	4	0.25	880.0	11	4	0.90	67%	0.131	0.09	0.01
Earth Scraper	24	1	0.1	52.8	40	4	1.61	67%	0.014	0.16	0.00
Loader	24	2	0.5	528.0	25	4	1.30	67%	0.113	0.13	0.01
Motor Grader	14	2	0.5	308.0	20	6	1.18	67%	0.060	0.12	0.01
Excavator - Trencher	0			0.0	17	4	1.09	67%	0.000	0.11	0.00
Fired Heaters	24	0	0	0.0	0.25	0	0.16	67%	0.000	0.02	0.00
Forklift	7	5	0.5	385.0	10	4	0.86	67%	0.055	0.09	0.01
Fusion Welder	0			0.0	0.25	2	0.16	67%	0.000	0.02	0.00
Heavy Haul / Cranes	0			0.0	75	2	2.13	67%	0.000	0.21	0.00
Light Plants	18	0	0	0.0	0.5	4	0.22	67%	0.000	0.02	0.00
Portable Compaction Roller	19	0	0	0.0	3	3	0.50	67%	0.000	0.05	0.00
Portable Compaction - Plate	15	0	0	0.0	0.1	0	0.11	67%	0.000	0.01	0.00
Portable Compaction - Ram	0			0.0	0.25	0	0.16	67%	0.000	0.02	0.00
Pumps	35	0	0	0.0	0.1	0	0.11	67%	0.000	0.01	0.00
Portable Power Generators	19	0	0	0.0	0.5	4	0.22	67%	0.000	0.02	0.00
Truck Crane - Greater than 200 ton	1	1	0.1	2.2	50	12	1.78	67%	0.001	0.18	0.00
Truck Crane - Greater than 300 ton	0			0.0	60	12	1.93	67%	0.000	0.19	0.00
Vibratory Roller 20 ton	27	2	0.25	297.0	20	3	1.18	67%	0.058	0.12	0.01
								Total	**4.22**		**0.42**
Worker personal vehicles	2028	1	0.5	22304.6	3	4	0.50	67%	1.846	0.05	0.18

Worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, average for months 1-12 divided by 1.3 employees per vehicle

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
Except for worker vehicles - parking area will be graveled and main road onsite will be paved
Water trucks operate at least 4 times per day.

Total Annual Fugitive Dust from Onsite Equipment - Months 1 - 12

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Grading	0.3498	0.0283
Bulldozing	4.6805	1.5505
Dirt Piling	0.0357	0.0054
Storage Piles	0.4763	0.0991
Travel on Unpaved Roads	4.2152	0.4215
TOTAL	**9.76**	**2.10**

Short term fugitive Dust Emissions

Maximum construction activity occurs in month 21.

1	month of dirt moving
22	construction days per month
10	construction hours per day
60%	average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35	k for PM_{10}
0.053	k for $PM_{2.5}$
6.25	U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19	M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006	lb of PM_{10}/ ton of material
0.00001	lb of $PM_{2.5}$/ ton of material

Equipment	Quantity	Hours/Day	Material Handled (ton/day)	Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Backhoe	1	6	58202	1,280,437	67%	0.2050	1.2298	0.0426	0.2558
					Total	**0.2050**	**1.2298**	**0.0426**	**0.2558**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

49323	yd3/day	58202	ton/day		
1,085,116	yd3	1,280,437	tons	2360	density of soil (lb/yd3) (USDA NRCS Physical Soil Properties from Kern County for Lockern-Buttonwillow clay)
134.25	acres =	1,085,116	cubic yds, assume depth of soils moved is	1.67	yd

(assume 25% of entire site in month 21)

Cover Storage Pile

SCAQMD Table A9-9-E

$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$

PM10 Emission factor from wind erosion of storage piles per day per acre

50	G = Silt content (%) (from onsite soil boring B-4)
37	H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3	I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5	J = Fraction of TSP that is PM10 = 0.5
0.791	lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Cover Storage Pile	25	0.25	24	67%	0.07	1.63	0.014	0.339

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size and number are assumed

Travel on unpaved road

$E = k (s/12)^a (w/3)^b$ Entrained dust estimates calculated using guidance from AP 42, Fifth Edition, Volume I Chapter 13.2.2: Unpaved Roads

$E_{ext} = E ((365-P)/365)$

Emission factor for vehicle travel on unpaved roads (lb/VMT)

	E = size-specific emission factor (lb/VMT)
4.00	s = surface material silt content (%) - Gravel Road
	W = mean vehicle weight (tons)
	E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
37	P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation (from WRCC for Bakersfield Airport Station)

Constant for Industrial Roads

	PM-2.5	PM-10
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Vehicle Type	No. Of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 EF (lbs/VMT)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Concrete Pumper Truck	1	2	0.75	1.5	30	10	1.41	67%	0.07	0.70	0.14	0.01	0.07
Dump Truck	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Service Truck - 1 ton	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Pile Driver Truck	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Truck - Fuel/Lube	0			0.0	15	10	1.03	67%	0.00	0.00	0.10	0.00	0.00
Tractor Truck 5th Wheel	0			0.0	11	10	0.90	67%	0.00	0.00	0.09	0.00	0.00
Trucks - Pickup 3/4 ton	5	10	0.5	25.0	3	4	0.50	67%	0.41	4.14	0.05	0.04	0.41
Trucks - 3 ton	2	2	0.5	2.0	11	10	0.90	67%	0.06	0.59	0.09	0.01	0.06
Truck - Water	1	4	1	4.0	25	10	1.30	67%	0.17	1.72	0.13	0.02	0.17
Air Compressor 185 CFM	0			0.0	0.5	2	0.22	67%	0.00	0.00	0.02	0.00	0.00
Air Compressor 750 CFM	4	1	0.01	0.0	0.5	2	0.22	67%	0.00	0.00	0.02	0.00	0.00
Articulating Boom Platform	0			0.0	5	10	0.63	67%	0.00	0.00	0.06	0.00	0.00
Bulldozer D10R	0			0.0	35	2	1.51	67%	0.00	0.00	0.15	0.00	0.00
Bulldozer D4C	0			0.0	15	2	1.03	67%	0.00	0.00	0.10	0.00	0.00
Concrete Trowel Machine	0			0.0	15	8	1.03	67%	0.00	0.00	0.10	0.00	0.00
Concrete Vibrators	0			0.0	0.25	0	0.16	67%	0.00	0.00	0.02	0.00	0.00
Cranes - Mobile 35 ton	7	1	0.1	0.7	25	12	1.30	67%	0.03	0.30	0.13	0.00	0.03
Cranes - Mobile 45 ton	0			0.0	35	2	1.51	67%	0.00	0.00	0.15	0.00	0.00
Crane - Mobile 65 ton	6	1	0.1	0.6	45	2	1.70	67%	0.03	0.34	0.17	0.00	0.03
Cranes 100 / 150 ton cap	4	0	0	0.0	50	12	1.78	67%	0.00	0.00	0.18	0.00	0.00
Diesel Powered Welder	3	0	0	0.0	0.5	2	0.22	67%	0.00	0.00	0.02	0.00	0.00
Backhoe/loader	1	4	0.25	1.0	11	4	0.90	67%	0.03	0.30	0.09	0.00	0.03
Earth Scraper	0			0.0	40	4	1.61	67%	0.00	0.00	0.16	0.00	0.00
Loader	0			0.0	25	4	1.30	67%	0.00	0.00	0.13	0.00	0.00
Motor Grader	0			0.0	20	6	1.18	67%	0.00	0.00	0.12	0.00	0.00
Excavator - Trencher	0			0.0	17	4	1.09	67%	0.00	0.00	0.11	0.00	0.00
Fired Heaters	5	0	0	0.0	0.25	0	0.16	67%	0.00	0.00	0.02	0.00	0.00
Forklift	3	5	0.5	7.5	10	4	0.86	67%	0.21	2.13	0.09	0.02	0.21
Fusion Welder	0			0.0	0.25	2	0.16	67%	0.00	0.00	0.02	0.00	0.00
Heavy Haul / Cranes	5	0	0	0.0	75	2	2.13	67%	0.00	0.00	0.21	0.00	0.00
Light Plants	6	0	0	0.0	0.5	4	0.22	67%	0.00	0.00	0.02	0.00	0.00
Portable Compaction Roller	2	0	0	0.0	3	3	0.50	67%	0.00	0.00	0.05	0.00	0.00
Portable Compaction - Plate	3	0	0	0.0	0.1	0	0.11	67%	0.00	0.00	0.01	0.00	0.00
Portable Compaction - Ram	0			0.0	0.25	0	0.16	67%	0.00	0.00	0.02	0.00	0.00
Pumps	2	0	0	0.0	0.1	0	0.11	67%	0.00	0.00	0.01	0.00	0.00
Portable Power Generators	5	0	0	0.0	0.5	4	0.22	67%	0.00	0.00	0.02	0.00	0.00
Truck Crane - Greater than 200 ton	4	1	0.1	0.4	50	12	1.78	67%	0.02	0.23	0.18	0.00	0.02
Truck Crane - Greater than 300 ton	2	0	0	0.0	60	12	1.93	67%	0.00	0.00	0.19	0.00	0.00
Vibratory Roller 20 ton	0			0.0	20	3	1.18	67%	0.00	0.00	0.12	0.00	0.00
								Total	**9.23**	**92.31**		**0.92**	**9.23**
Worker personal vehicles	989	1	0.5	494.6	3	4	0.50	67%	8.19	81.85	0.05	0.82	8.19

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants. Parking area will be graveled and main onsite road will be paved.
Water trucks operate at least 4 times per day.

10 Maximum number of construction work hours per day

Total Fugitive Dust from Onsite Equipment - Month 21

	PM_{10} Emissions (lb/day)	$PM_{2.5}$ Emissions (lb/day)
Dirt Piling	1.2298	0.2558
Storage Piles	1.6313	0.3393
Travel on Unpaved Roads	92.3095	9.2310
TOTAL	**95.17**	**9.83**

Annual Fugitive Dust Emissions

Maximum annual fugitive dust activity occurs in months 17-28.

7 months of soil disturbance
10 total construction hours per work day
22 construction days per month
60% average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Scraper	1,691,750	67%	0.018	0.003
Loader	1,522,575	67%	0.016	0.002
Backhoe	169,175	67%	0.002	0.000
	3,383,500	**Total**	**0.036**	**0.005**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
assume scraper handles 50% of dirt, loader 45%, and backhoe 5%

18,619 yd^3/day 21,971 ton/day 2360 density of soil (lb/yd^3)
2,867,373 yd^3 3,383,500 tons (USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
354.75 acres = 2,867,373 cubic yds, assume depth of soils moved is 1.67 yd
(assume 75% of entire site in 12 month period)

Cover Storage Pile

SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	40	0.25	365	67%	0.48	0.099

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road

$E = k (s/12)^a (w/3)^b$ Entrained dust estimates calculated using guidance from AP 42, Fifth Edition, Volume I Chapter 13.2.2: Unpaved Roads
$E_{ext} = E ((365-P)/365)$
Emission factor for vehicle travel on unpaved roads (lb/VMT)

E = size-specific emission factor (lb/VMT)
4.00 s = surface material silt content (%) - Gravel Road
W = mean vehicle weight (tons)
E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
37 P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation (from WRCC for Bakersfield Airport Station)

Constant for Industrial Roads

	PM-2.5	PM-10
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 EF (lbs/VMT)	PM2.5 Emissions (tons/yr)
Concrete Pumper Truck	6	2	0.75	198.0	30	10	1.41	67%	0.046	0.14	0.00
Dump Truck	0			0.0	15	10	1.03	67%	0.000	0.10	0.00
Service Truck - 1 ton	0			0.0	15	10	1.03	67%	0.000	0.10	0.00
Pile Driver Truck	0			0.0	15	10	1.03	67%	0.000	0.10	0.00
Truck - Fuel/Lube	0			0.0	15	10	1.03	67%	0.000	0.10	0.00
Tractor Truck 5th Wheel	0			0.0	11	10	0.90	67%	0.000	0.09	0.00
Trucks - Pickup 3/4 ton	60	10	0.5	6600.0	3	4	0.50	67%	0.546	0.05	0.05
Trucks - 3 ton	24	2	0.5	528.0	11	10	0.90	67%	0.078	0.09	0.01
Truck - Water	12	4	1	1056.0	25	10	1.30	67%	0.227	0.13	0.02
Air Compressor 185 CFM	0			0.0	0.5	2	0.22	67%	0.000	0.02	0.00
Air Compressor 750 CFM	48	1	0.01	10.6	0.5	2	0.22	67%	0.000	0.02	0.00
Articulating Boom Platform	0			0.0	5	10	0.63	67%	0.000	0.06	0.00
Bulldozer D10R	0			0.0	35	2	1.51	67%	0.000	0.15	0.00
Bulldozer D4C	0			0.0	15	2	1.03	67%	0.000	0.10	0.00
Concrete Trowel Machine	12	1	0.25	66.0	15	8	1.03	67%	0.011	0.10	0.00
Concrete Vibrators	0			0.0	0.25	0	0.16	67%	0.000	0.02	0.00
Cranes - Mobile 35 ton	80	1	0.1	176.0	25	12	1.30	67%	0.038	0.13	0.00
Cranes - Mobile 45 ton	0			0.0	35	2	1.51	67%	0.000	0.15	0.00
Crane - Mobile 65 ton	70	1	0.1	154.0	45	2	1.70	67%	0.043	0.17	0.00
Cranes 100 / 150 ton cap	48	0	0	0.0	50	12	1.78	67%	0.000	0.18	0.00
Diesel Powered Welder	41	0	0	0.0	0.5	2	0.22	67%	0.000	0.02	0.00
Backhoe/loader	6	4	0.25	132.0	11	4	0.90	67%	0.020	0.09	0.00
Earth Scraper	0			0.0	40	4	1.61	67%	0.000	0.16	0.00
Loader	0			0.0	25	4	1.30	67%	0.000	0.13	0.00
Motor Grader	0			0.0	20	6	1.18	67%	0.000	0.12	0.00
Excavator - Trencher	0			0.0	17	4	1.09	67%	0.000	0.11	0.00
Fired Heaters	53	0	0	0.0	0.25	0	0.16	67%	0.000	0.02	0.00
Forklift	36	5	0.5	1980.0	10	4	0.86	67%	0.282	0.09	0.03
Fusion Welder	0			0.0	0.25	2	0.16	67%	0.000	0.02	0.00
Heavy Haul / Cranes	32	0	0	0.0	75	2	2.13	67%	0.000	0.21	0.00
Light Plants	84	0	0	0.0	0.5	4	0.22	67%	0.000	0.02	0.00
Portable Compaction Roller	10	0	0	0.0	3	3	0.50	67%	0.000	0.05	0.00
Portable Compaction - Plate	18	0	0	0.0	0.1	0	0.11	67%	0.000	0.01	0.00
Portable Compaction - Ram	0			0.0	0.25	0	0.16	67%	0.000	0.02	0.00
Pumps	24	0	0	0.0	0.1	0	0.11	67%	0.000	0.01	0.00
Portable Power Generators	60	0	0	0.0	0.5	4	0.22	67%	0.000	0.02	0.00
Truck Crane - Greater than 200 ton	42	1	0.1	92.4	50	12	1.78	67%	0.027	0.18	0.00
Truck Crane - Greater than 300 ton	27	0	0	0.0	60	12	1.93	67%	0.000	0.19	0.00
Vibratory Roller 20 ton	0			0.0	20	3	1.18	67%	0.000	0.12	0.00
								Total	**11.26**		**1.13**
Worker personal vehicles	10919	1	0.5	120111.5	3	4	0.50	67%	9.939	0.05	0.99

Worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, average for months 17-28 divided by 1.3 employees per vehicle

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
except for worker vehicles - parking area will be graveled and main road onsite will be paved
Water trucks operate at least 4 times per day.

Total Annual Fugitive Dust from Onsite Equipment - Months 17 - 28

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Dirt Piling	0.0357	0.0054
Storage Piles	0.4763	0.0991
Travel on Unpaved Roads	11.2573	1.1257
TOTAL	**11.77**	**1.23**

Hydrogen Energy, Inc *5/12/2010*
HECA Project

Annual Fugitive Dust Emissions for Offsite Linears
Maximum annual fugitive dust activity occurs in months 1-12.

12 months of soil disturbance
10 total construction hours per work day
22 construction days per month

Dirt Piling or Material Handling
$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$ PM_{10} Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

12 G = Mean Wind speed (mph) default
15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)
0.00021 lb of PM_{10}/ ton of material

Equipment	Quantity/ year	Hours/ Day	Annual Material Handled (ton)	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Backhoe	12	10	1,102,262	67%	0.0379	0.0079
				Total	**0.0379**	**0.0079**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

3538 yd^3/day 4175 ton/day
934,120 yd^3 1,102,262 tons 2360 density of soil (lb/yd^3)
(USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
193 acres = 934,120 cubic yds, assume depth of soils moved is 1 yd

Storage Piles
SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from Geotechnical Investigaion, AFC Appendix P)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Storage Piles	8	0.25	365	67%	0.10	0.020

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road
$E = k (s/12)^a (w/3)^b$ Entrained dust estimates calculated using guidance from AP 42, Fifth Edition, Volume I Chapter 13.2.2: Unpaved Roads
$E_{ext} = E ((365-P)/365)$
Emission factor for vehicle travel on unpaved roads (lb/VMT)

E = size-specific emission factor (lb/VMT)
4.00 s = surface material silt content (%) - Gravel Road
W = mean vehicle weight (tons)
E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
37 P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation (from WRCC for Bakersfield Airport Station)

Constant for Industrial Roads

	PM-2.5	PM-10
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance on Dirt Surface (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM_{10} EF (lbs/VMT)	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	PM2.5 EF (lbs/VMT)	$PM_{2.5}$ Emissions (tons/yr)
ON ROAD											
Dump Truck	12	4	0.25	264.0	17	10	1.09	67%	0.048	0.11	0.00
Service Truck (MHD-DSL)	0	1	0.125	0.0	4	6	0.57	67%	0.000	0.06	0.00
Pipe Haul Truck and Trailer (HHDT-DSL	12			0.0	15	10	1.03	67%	0.000	0.10	0.00
Truck (Pickup 3/4 Ton) - MHD-DSL	17	2	0.25	187.0	1	4	0.31	67%	0.009	0.03	0.00
Truck - water	12	4	0.25	264.0	25	10	1.30	67%	0.057	0.13	0.01
OFF ROAD							0.00	67%	0.000	0.00	0.00
Air Compressor	10					4	0.00	67%	0.000	0.00	0.00
Bore Machine (Hydraulic)	5					10	0.00	67%	0.000	0.00	0.00
Crane	5					10	0.00	67%	0.000	0.00	0.00
Backhoe	12					2	0.00	67%	0.000	0.00	0.00
Excavator	12	1	0.25	66.0	17	4	1.09	67%	0.012	0.11	0.00
Forklift	4	4	0.25	88.0	10	4	0.86	67%	0.013	0.09	0.00
Welding Generator	4					3	0.00	67%	0.000	0.00	0.00
Roller	12	4	0.25	264.0	20	3	1.18	67%	0.051	0.12	0.01
Pipe Bending Machine	12						0.00	67%	0.000	0.00	0.00
Worker personal vehicles	2028	1	0.125	5576.2	3	4	0.50	67%	0.461	0.05	0.05
								Total	**0.6510**		**0.0651**

Offsite worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, average for months 1-12 divided by 1.3 employees per vehicle

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
except for worker vehicles - parking area will be graveled and main road onsite will be paved
Water trucks operate at least 4 times per day.
Truck quantity based on monthly maximums

Total Annual Fugitive Dust from Offsite Linears Construction

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Dirt Piling or Material Handling	0.0379	0.0079
Storage Piles	0.0953	0.0198
Travel on unpaved road	0.6510	0.0651
TOTAL	**0.7841**	**0.0928**

WORKSHOP REQUEST

25. Please provide a copy of the modeling files for the construction PM10 and PM2.5 emission modeling analysis to Will Walters.

RESPONSE

The modeling files were provided in December 2009 on a CD with the response to CEC Set One Data Request No. 6. The files were submitted directly to Will Walters via email on April 27, 2010. Because the files were previously docketed, they have not been resubmitted with this document.

WORKSHOP REQUEST

26. Please provide the dates of emission reductions for the ERCs explicitly identified for the HECA Project.

RESPONSE

The dates were provided by San Joaquin Valley Air Pollution Control District (SJVAPCD) to Will Walters on April 13, 2010, as shown on Attachment 26-1.

ATTACHMENT 26-1

To: <WWalters@aspeneg.com>
From: "Leonard Scandura" <Leonard.Scandura@valleyair.org>
Date: 04/13/2010 10:49AM
cc: <gregory.skannal@hydrogenenergy.com>, "Julie Mitchell" <Julie_Mitchell@URSCorp.com>, "Homero Ramirez" <Homero.Ramirez@valleyair.org>, "Allan Phillips" <Allan.Phillips@valleyair.org>
Subject: HECA emission reduction credits

Will -

Per you inquiry at the 4/12/10 CEC Data Response Workshop for the HECA project, below are the dates of emission reductions for the ERCs explicitly identified for the HECA project (per their 4/2/10 CEC submittal - Response to Data Request No. 8").

ERC#	pollutant	tpy	date of emission reduction
S-3273-2	NOx	241.00	11/30/83
S3275-5	SOx	84.00	3/1/92
S-3305-1	VOC	29.25	9/10/79
C-1058-2	NOx	20.20	1/7/08
C-1058-5	SOx	49.00	1/7/08

In reading HECA's 4/2/10 submittal, the above ERCs have been purchased (confirmed by our records) for use for the project. However, additional ERCs from AER Glan (VOC) and GIC Financial Services (NOx and SOx) will be procured later in the project development process. As such, the ERCs identified in this submittal represent just a portion of their offset package.

Please let me know if there is any other information from our records that we can provide to you.

Thanks

Leonard Scandura
Permit Services Manager
SJVAPCD
661-392-5601

WORKSHOP REQUEST

27. Staff is aware that HECA is working with SJVAPCD on reducing NO_X emissions through a voluntary agreement.

RESPONSE

The voluntary agreement is expected to be completed by the time the Preliminary Determination of Compliance is issued in mid-June 2010.

WORKSHOP REQUEST

28. Please provide a description of each process stream and its purpose. Provide the VOC and TAC content of each stream.

RESPONSE

Table 28-1 provides a brief description of each process stream evaluated for fugitive emissions and an explanation of volatile organic compounds (VOCs) expected to be present. Figure 28-1 shows the locations of each process area listed in Table 28-1 on the process flow diagram.

The expected VOC and toxic air contaminant content of the gas in each process stream is provided for all streams in Table 28-2. The content of the syngas and flash gas streams will be provided to the CEC under confidential cover.

Table 28-1
Process Stream and VOC Descriptions

No.	Name	Stream Description	VOC Description
1	Methanol	Solvent for Rectisol Process	Entire stream is VOC
2	Syngas	Sour syngas from gasifier outlet to Shift Unit	Trace amounts of COS and HCN (gasifier byproducts)
3	Flash Gas	Gas released from depressuring gasifier quench water	Trace amounts of COS and HCN (gasifier byproducts)
4	Shifted Syngas	Syngas from Shift Unit to Rectisol Unit	Trace amount of COS (gasifier byproduct)
5	Propylene	Rectisol Process refrigerant	Entire stream is VOC
6	Sour Water	Process wastewater from gasification containing sulfide and ammonia	(none)
7	H_2S Laden Methanol	Rich solvent in Rectisol Unit containing H_2S and CO_2	Methanol and trace amount of COS (gasifier byproduct)
8	CO_2 Laden Methanol	Rich solvent in Rectisol Unit containing CO_2 with H_2S removed	Methanol
9	Acid Gas	Concentrated CO_2 and H_2S from Rectisol to SRU	Entrained solvent (methanol) and trace amount of COS (gasifier byproduct)
10	Ammonia Laden Gases	Offgas from process wastewater treating containing ammonia and H_2S	Trace amounts of COS and HCN (gasifier byproducts)
11	Sulfur	Liquid elemental sulfur product from the SRU	(none)
12	TGTU Process Gas	Tail gas from Claus Units, TGTU feed	Trace amount of COS (gasifier byproduct)
13	TGTU Amine	Rich amine from TGTU, aqueous solution of methyl diethanol amine containing H_2S	Amine is a VOC

Notes:

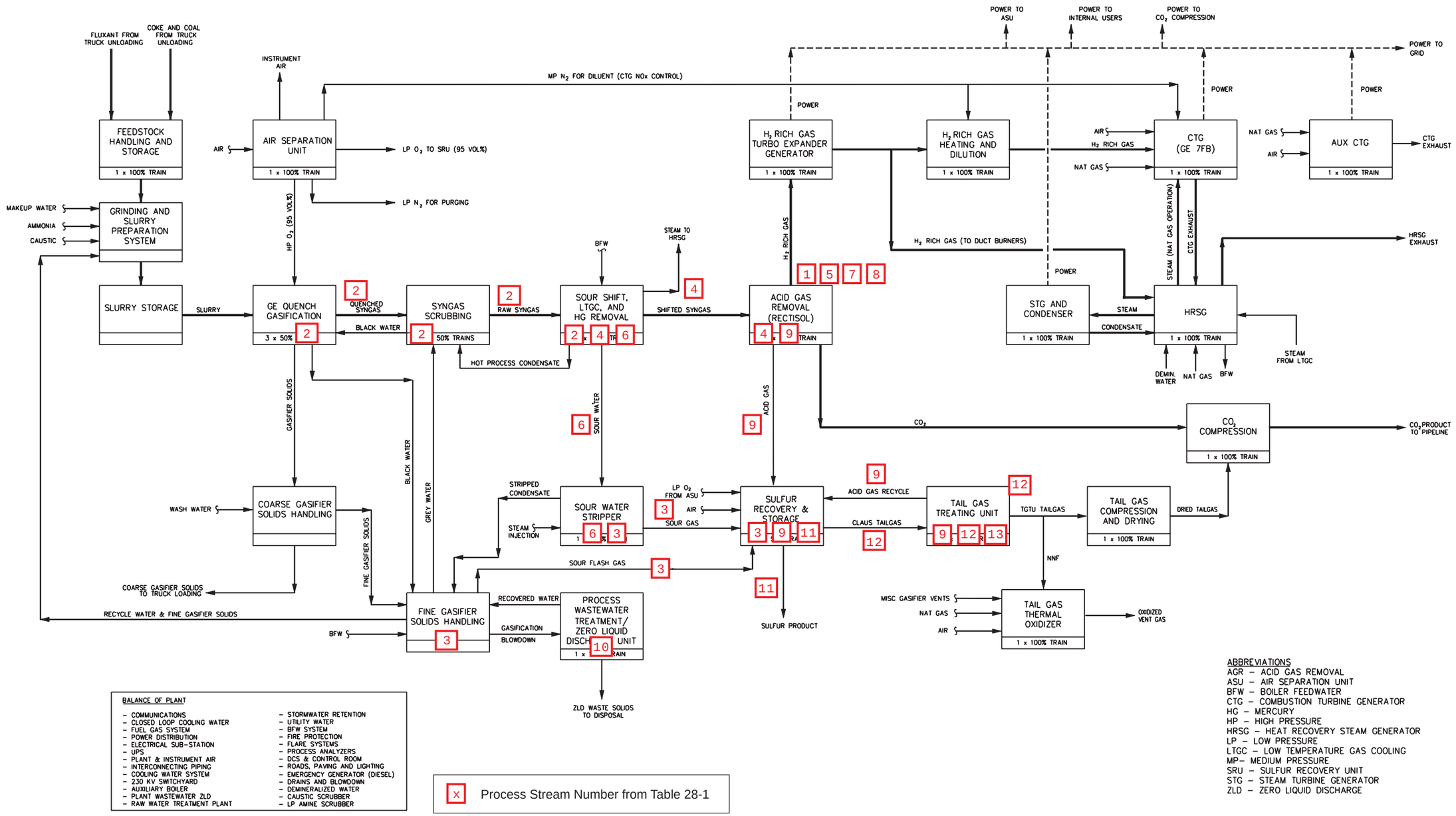
CO_2	=	carbon dioxide
COS	=	carbonyl sulfide
H_2S	=	hydrogen sulfide
HCN	=	hydrogen cyanide
SRU	=	sulfur recovery unit
TGTU	=	tail gas treating unit
VOC	=	volatile organic compounds

Table 28-2
Process Stream VOC, HAP, and Criteria Pollutant Content

Compound	Wt %												
	Methanol Stream	Syngas	Flash Gas	Shifted Syngas Stream	Propylene Stream	Sour Water Stream	H_2S Laden Methanol Stream	CO_2 Laden Methanol Stream	Acid Gas Stream	Ammonia-Laden Gas Stream	Sulfur Stream	TGTU Process Gas Stream	TGTU Amine Stream
CO_2	0.00%			90.43%	0.00%	2.50%	44.68%	35.81%	60.32%	68.32%	0.00%	64.65%	1.98%
CO	0.00%			1.48%	0.00%	0.001%	0.03%	0.04%	0.06%	0.36%	0.00%	0.31%	0.00%
CH_4	0.00%			0.06%	0.00%	0.00%	0.003%	0.003%	0.002%	0.002%	0.00%	0.00%	0.00%
H_2S	0.00%			2.05%	0.00%	0.18%	1.73%	0.0001%	39.04%	5.98%	0.03%	1.86%	0.32%
COS	0.00%			0.01%	0.00%	0.00%	0.01%	0.00%	0.51%	0.02%	0.00%	0.03%	0.00%
CH_3OH	100.00%			0.00%	0.00%	0.00%	53.51%	64.10%	0.03%	0.00%	0.00%	0.00%	0.00%
C_3H_6	0.00%			0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
NH_3	0.00%			0.00%	0.00%	0.25%	0.00%	0.00%	0.00%	7.36%	0.00%	0.00%	0.00%
HCN	0.00%			0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%	0.00%
MDEA	0.00%			0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	43.96%

Notes:

C_3H_6 = propylene
CH_3OH = methanol
CH_4 = methane
CO = carbon monoxide
CO_2 = carbon dioxide
COS = carbonyl sulfide
H_2S = hydrogen sulfide
HAP = hazardous air pollutant
HCN = hydrogen cyanide
MDEA = methyldiethanol amine
NH_3 = ammonia
TGTU = tail gas treating unit
VOC = volatile organic compound



Source:
Fluor; Hydrogen Energy California, Kern County Power Project;
Block Flow Diagram; Drawing No: A3RW-BFD-25-001, Rev. 4 (04/13/09)

PROCESS STREAMS EVALUATED FOR FUGITIVE EMISSIONS

June 2010 Hydrogen Energy California (HECA)
28067571 Kern County, California

URS

FIGURE 28-1

WORKSHOP REQUEST

29. Need to develop a consensus with San Joaquin Valley Air Pollution Control District (SJVAPCD) regarding the estimation of $PM_{2.5}$ emissions from the cooling towers.

RESPONSE

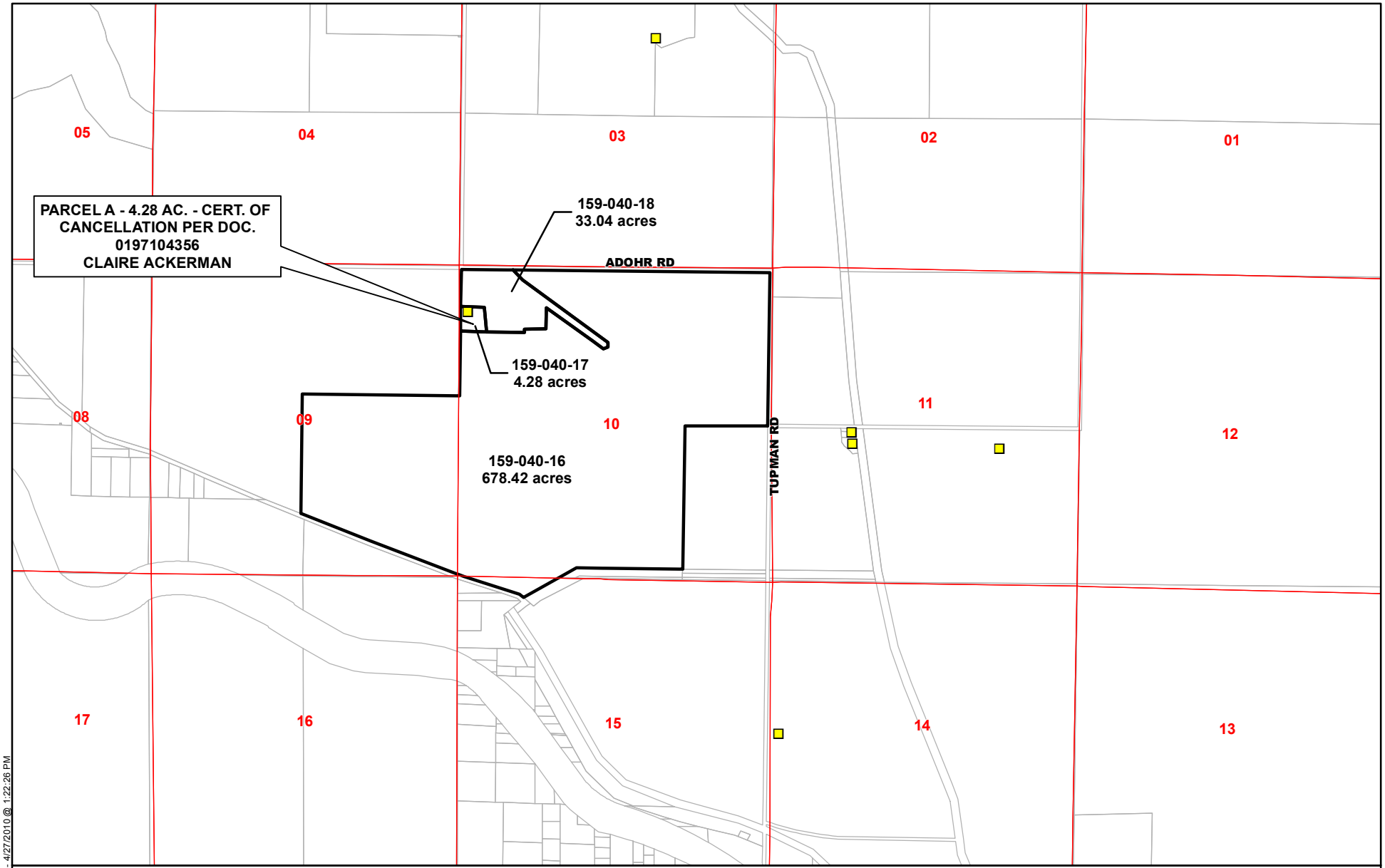
SJVAPCD informed the Applicant that they agreed with the apportionment of PM_{10} and $PM_{2.5}$ emissions from the cooling towers. SJVAPCD will provide written confirmation to CEC regarding the particulate matter emissions from the cooling towers.

WORKSHOP REQUEST

30. Please provide a clearer "Ackerman Property" figure and map the residences nearby.

RESPONSE

Figure 37-1, Ackerman Property, from the response to CEC Set One Data Request No. 37, has been revised as requested and is attached. In addition, please refer to Figure 5.4-2 of the Revised AFC for the locations of the nearest dwellings.



LEGEND

- Residence
- Parcel line
- Section line - Township 30 south, Range 24 east

N

0 1,000 2,000 Feet

ACKERMAN PROPERTY

June 2010
28067571

Hydrogen Energy California (HECA)
Kern County, California

URS

REVISED FIGURE FOR ATTACHMENT 37-1

U:\GIS\HECA\Projects\Ackerman.mxd - 4/27/2010 @ 1:22:26 PM

Source: Parcel lines, County of Kern, California 2008; Section lines, CASIL 2005.

WORKSHOP REQUEST

31. Please provide a consolidated table with all Greenhouse Gas (GHG) emissions calculated for the entire construction period.

RESPONSE

As previously stated in the response to CEC Set One Data Request No. 43, the greenhouse gas emissions from all construction-related activities were presented in a series of tables in Appendix D1.1 of the Revised AFC. Table 31-1 summarizes the greenhouse gas emissions for the entire construction period.

Table 31-1
Estimated Greenhouse Gas Emissions for The Entire Construction Period
(metric tons/44 months construction period)

Activity	CO_2	CH_4	N_2O	CO_2e
Onsite Construction Emissions				
Construction Equipment and Trucks	7,735.78	0.96	0.18	7,812.67
Worker Vehicles	963.46	0.07	0.04	976.05
Delivery Trucks	382.38	0.01	0.01	384.23
Subtotal of Onsite Emissions	**9,081.62**	**1.04**	**2.24E-01**	**9,172.94**
Offsite Construction Emissions				
Construction Equipment and Trucks	422.46	0.06	0.01	426.39
Worker Vehicles	24,728.72	1.82	0.92	25,051.88
Delivery Trucks	7,265.29	0.15	0.10	7,300.38
Subtotal of Offsite Emissions	**32,416.46**	**2.03**	**1.03**	**32,778.65**
Total Construction GHG Emissions	**41,498.08**	**3.08**	**1.25**	**41,951.60**

Notes:

Offsite construction equipment emissions are from linear (e.g., transmission line and pipeline) construction activities.

Assumes 66% long-term average operational load for construction equipment and trucks emissions.

Emissions from worker vehicles are based on actual worker schedule data from Table 2-25, Estimated Monthly Construction Workforce from Revised AFC.

CH_4 = methane
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
N_2O = nitrous oxide

WORKSHOP REQUEST

32. Please provide an annual limit on Greenhouse Gas emissions from the CO2 vent.

RESPONSE

The maximum CO_2 to be emitted from the CO_2 vent is anticipated to be 150,011 tonnes per year. It should be noted that the CO_2 vent is a safety device that releases the CO_2 stream in the event of an emergency. Although it is anticipated that all unplanned venting should be covered under the limit described above, a hard limit on the amount of venting may produce an unsafe operating environment.

WORKSHOP REQUEST

33. Please provide official submittals to and correspondence with SJVAPCD.

RESPONSE

The Applicant has provided the CEC with copies of official SJVAPCD submittals and correspondence and will continue to provide official correspondence to the CEC as it is exchanged with SJVAPCD.

WORKSHOP REQUEST

34. Please provide the status of the PSD permit.

RESPONSE

As the Applicant noted during the April 12, 2010 CEC Workshop, the Prevention of Significant Deterioration (PSD) permit application is still in review by the U.S. EPA and the Federal Land Manager (FLM).

WORKSHOP REQUEST

35. Please provide a copy of the Applicant's responses to the Federal Land Manager (FLM) comments on the PSD permit application.

RESPONSE

Attachment 35-1 presents the Applicant's April 26, 2010 responses to questions from the FLM regarding the Class I Area modeling analyses. To date, the Applicant has not received further communication from the FLM regarding the responses.

ATTACHMENT 35-1

APRIL 2010

RESPONSES TO FEDERAL LAND MANAGER (FLM) COMMENTS ON CALPUFF MODELING IN THE OCTOBER 2009

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) PERMIT APPLICATION

REVISED APPLICATION FOR CERTIFICATION

(08-AFC-8)

FOR HYDROGEN ENERGY CALIFORNIA

KERN COUNTY, CALIFORNIA

Prepared by

URS CORPORATION
1615 Murray Canyon Road, Suite 1000
San Diego, CA, 92108
URS Project Number 28067571

COMMENT

1. Why was the HECA CALPUFF modeling limited to only the San Rafael Wilderness? Other Class I areas like Dome Land Wilderness and Sequoia National Park are just beyond 100 km distant from HECA, but are located more along the expected prevailing winds for the area. This question was previously raised in comments on the April 22, 2008 modeling protocol.

RESPONSE

National Park Service (NPS) commented on the modeling protocol on April 28, 2008 regarding these Class I areas. NPS stated that they did not believe that there is any significant air quality impact at Class I areas beyond a 100-km distance from HECA, based on the distance and low emissions. The following is the comment from NPS:

> *"Thank you for sending the HECA air quality modeling protocol to us for review. Based on the information presented in the protocol, the distance to the nearest National Park Service Class I area (Sequoia National Park) is 125 kilometers and the emissions from the proposed HECA facility are 234 TPY of NOx , 36 TPY of SO2, 207 TPY of PM10 and 41 TPY of VOCs. We feel that given the distance and low emissions, we do not believe there will be any significant air quality impacts at Sequoia National Park. However, in the modeling protocol I read the following statement (page 5-1): "Three Class I areas are located within the region of the HECA site and require further evaluation: Dome Land Wilderness Area, Sequoia National Park, and San Rafael Wilderness Area. However, detailed review of the locations of these Class I areas relative to the HECA site shows that Dome Land Wilderness Area and Sequoia National Park are greater than 100 km from HECA. Therefore, these two Class I areas do not meet the criterion of being within 100 km and will not be included in the HECA analysis." For future PSD applicants, we ask that large sources (large emissions) complete an air quality analyses for Class I areas beyond 100 km and we be given the opportunity to review the modeling protocol and PSD applications for large sources."*

After HECA amended the PSD application in October 2009 to exclude the auxiliary turbine, the total emissions from the proposed HECA facility dropped to 186 TPY of NO_x, 38 TPY of SO_2, and 111 TPY of PM_{10}. These revised emissions are significantly lower than those proposed by HECA in the June 2009 PSD application; therefore, it supports the NPS' comments regarding no expected significant air quality impacts at Sequoia National Park.

Figure 1 presents the CALMET/CALPUFF modeling domain with the HECA Project Site location, San Rafael Wilderness Area, Bakersfield, Santa Maria, and Santa Barbara areas.

A windrose of annual Bakersfield surface winds is presented in Figure 2. It shows that the wind blows predominantly from the northwest with occasional southeasterly winds, primarily during the winter; therefore, the most frequent plume transport is toward the southeast. Santa Maria surface data shows that the wind blows almost exclusively from the northwest toward the southeast as shown in Figure 3. Both Dome Land Wilderness area and Sequoia National Park are located northeast of the HECA. Therefore, the plume from HECA is unlikely to be transported to these Class I areas.

Santa Barbara surface data shows that the wind blows dominantly from south toward north as shown in Figure 4. Los Angeles surface data shows that the wind blows dominantly from south-southwest toward east-northeast as shown in Figure 5. Therefore, San Gabriel Wilderness Area and Cucamonga Wilderness Area are more likely affected by the sources in Los Angeles area rather than sources in HECA project location.

Also, current CALPUFF modeling results show that the criteria pollutant concentrations and Nitrogen and Sulfur deposition rates are well below the thresholds (i.e., the criteria pollutant concentrations are between 1 percent and 30 percent of the Significant Impact Level (SIL), and the Nitrogen and Sulfur deposition rates are between 3 percent and 7 percent of corresponding thresholds).

Modeled visibility reductions for each modeled year were compared to the level of acceptable extinction change (LAC) of 5 percent. The visibility impact is greater than 5 percent, but less than 10 percent of cumulative modeling threshold. The number of days that exceeds 5 percent of extinction change is 1 day for 2001 and 2003, and 3 days for 2002. The Class I modeling analyses were performed based on an operating scenario with very conservative emission rates. These emissions are discussed later in this document. Not only was each source emission rate estimated based on worst-case scenario, the model conservatively assumed that all the sources will be operated in this mode everyday. Based on these conservative emission rates, it is expected that no significant visibility impact would occur due to proposed project.

Based on these reasons, it is expected that the air quality impact of the HECA project on Dome Land Wilderness Area, Sequoia National Park, and even the more distant San Gabriel Wilderness Area and Cucamonga Wilderness Area would be less than predicted in the San Rafael Wilderness Area. Consequently, the impact would be less than significant in these more distant Wilderness Areas.

Figure 1. CALMET/CALPUFF Modeling Domain

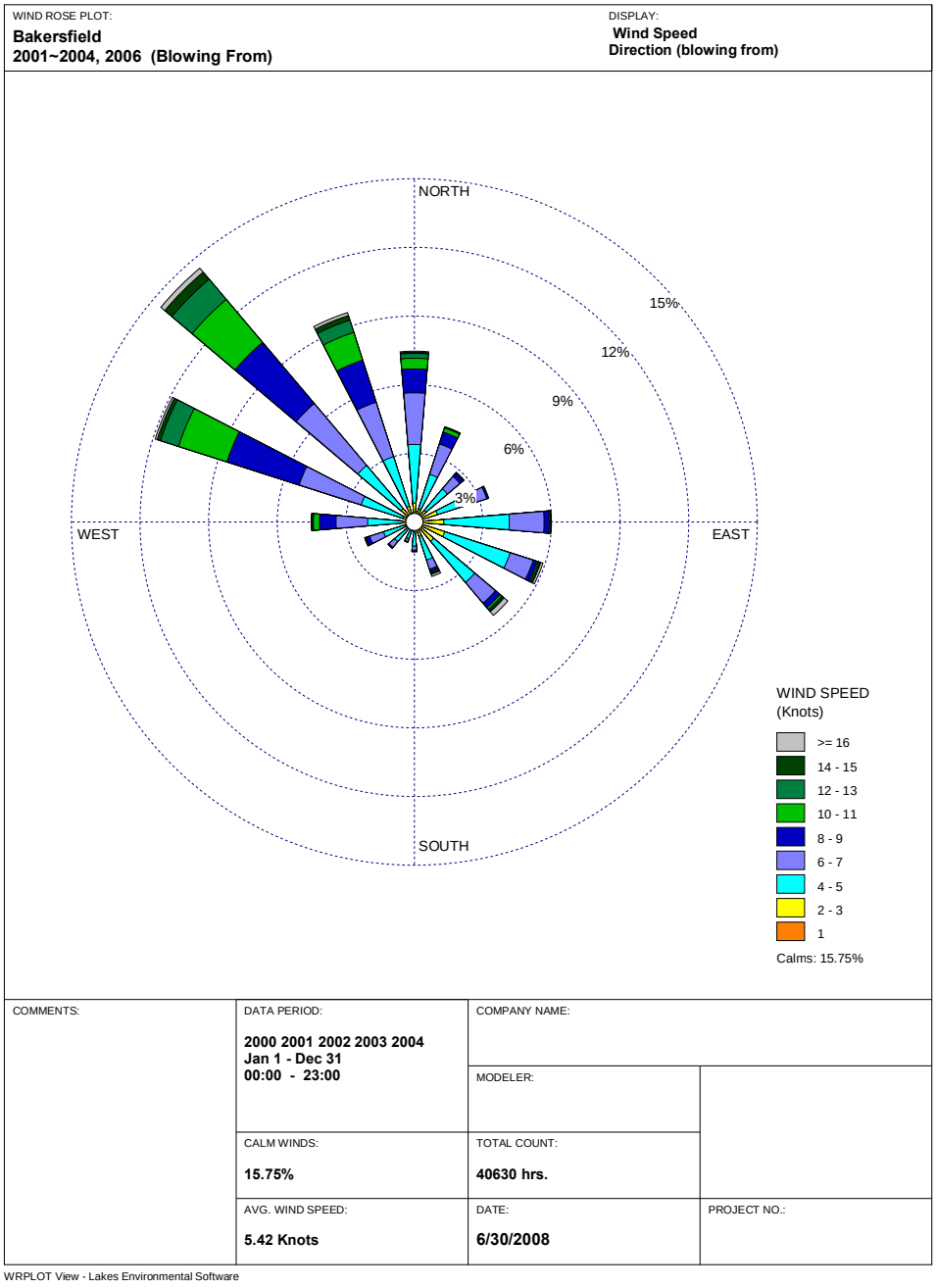


Figure 2. Windrose at Bakersfield, CA (Average of 2001, 2002, 2003, 2004, and 2006)

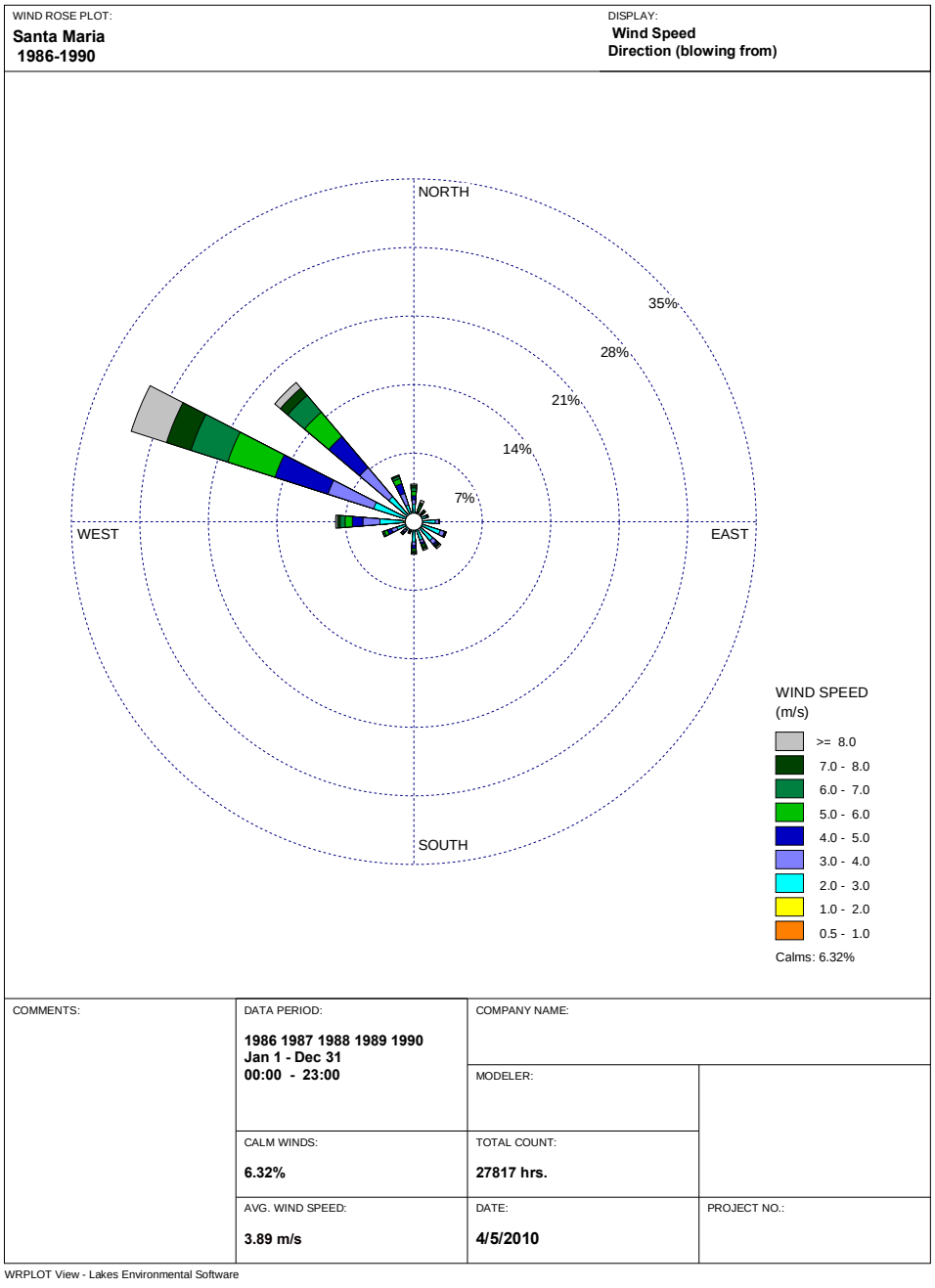


Figure 3. Windrose at Santa Maria, CA (Average of1986-1990)

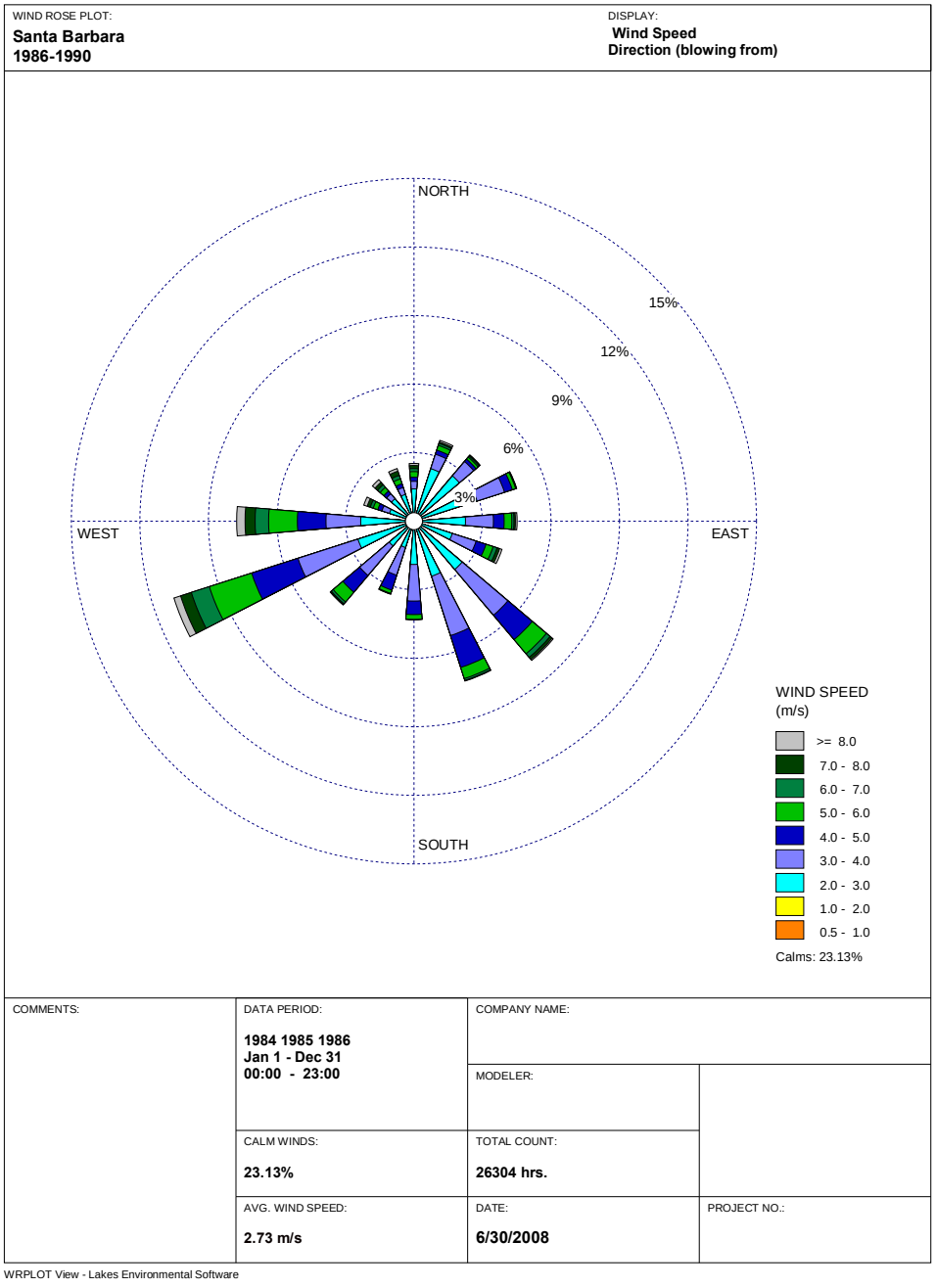


Figure 4. Windrose at Santa Barbara, CA (Average of 1986-1990)

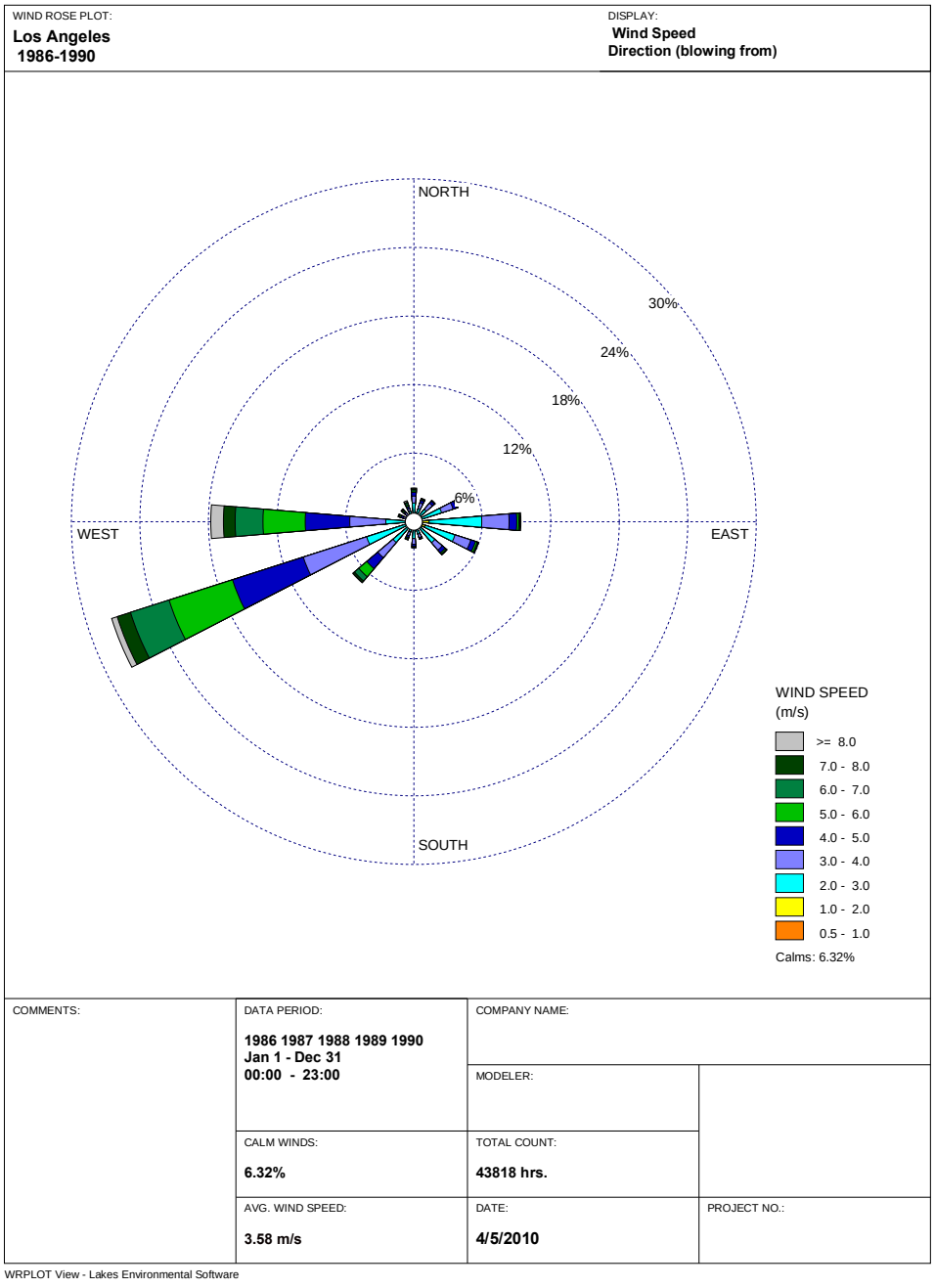


Figure 5. Windrose at Los Angeles, CA (Average of 1986-1990)

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COMMENT

2. What upper air stations are located in and near the modeling domain and could have been used if the modeling had chosen to include upper air stations?

RESPONSE

There are three upper air stations located in the modeling domain. Point Mugu (WBAN 93111, WMO ID 72391, Lat 34.10, Long -119.12); Vandenberg (WBAN 93214, WMO ID 72393, Lat 34.75, long -120.57); and Vandenberg AFB (WBAN 93223, WMO ID 74606, Lat 34.67, Long -120.58). For Point Mugu station, no data is available for the time period of MM5 meteorological data (2001 through 2003). Vandenberg and Vandenberg AFB stations have very spotty and incomplete data.

Therefore, no observed upper-air meteorological observations were used in the CALMET/CALPUFF modeling analysis as they are not available in the modeling domain.

In addition, Western Regional Air Partnership (WRAP) explains that the twice daily upper-air meteorological observations are used as input with the MM5 model estimates nudged to the observations as part of the Four Dimensional Data Assimilation (FDDA) in the application of the MM5. This results in higher temporal (hourly vs. 12-hour) and spatial (36 km vs. approximately 300 km) resolution upper-air meteorology in the MM5 field that is dynamically balanced than contained in the upper-air observations. Therefore, the use of the upper-air observations with CALMET may upset the dynamic balance of the meteorological fields potentially producing spurious vertical velocities.

COMMENT

3. Please justify the use of 10 ppb for the background ammonia levels. Other San Joaquin Valley CALPUFF modeling studies have used 20 ppb for the background ammonia. This issue was also raised in comments on the April 22, 2008 modeling protocol.

RESPONSE

The project site is located in western unincorporated Kern County, approximately 7 miles west of the outermost edge of the city of Bakersfield, 1.5 miles northwest of the unincorporated community of Tupman, and approximately 4 miles southeast of the unincorporated community of Buttonwillow. The predominant land uses within the Kern County include agriculture, oil production, mineral exploration (including gold, borate, and kernite), residential, and military installations (including Edwards Air Force Base and China Lake Naval Air Weapons Station). The Western Regional Air Partnership (WRAP) used the 1 ppb of the monthly background ammonia concentration for this region because they believed that the region is arid land. However, the HECA analysis used a monthly background ammonia concentration of 10 ppb, which is the recommended IWAQM Phase II report value for "grasslands", which is often used for agricultural areas.

The following figures show the ammonia concentrations measured from Bakersfield – Van Horn School and Kern Wildlife Refuge in San Joaquin Valley (Dave Mitchell, SJVAPCD, Presentation Slides for NADP Ammonia Workshop presented in Washington, DC on October 23, 2003. http://www.docstoc.com/docs/5693004/Ammonia-Regulation-%E2%80%93-Are-We-Ready). The average ammonia (NH_3) concentration observed during 72 hours is 10.1 ppb from Bakersfield – Van Horn School and 6.1 ppb from Kern Wildlife Refuge.

Therefore, it is reasonable to use 10 ppb of monthly ammonia concentration for HECA project located in Kern County.

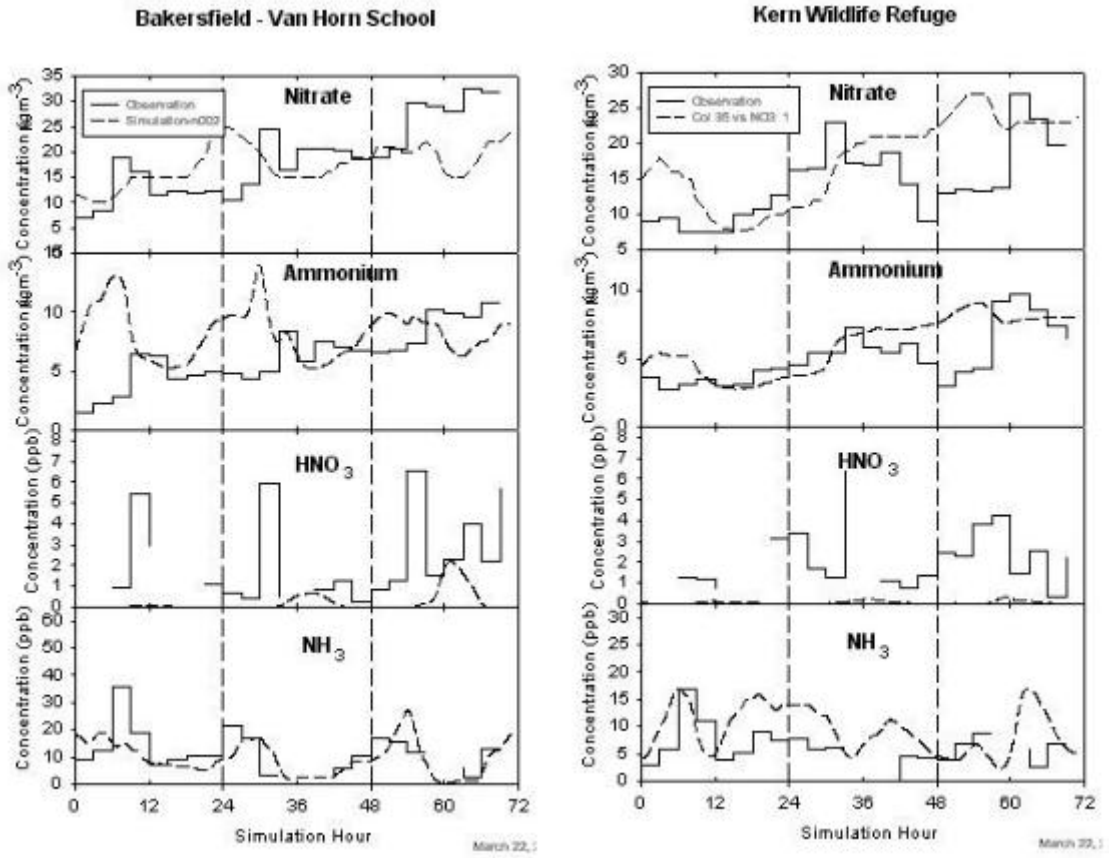

Figure 6. Ammonia Concentration Observed at Bakersfield-Van Horn School and Kern Wildlife Refuge (Dave Mitchell, 2003)

COMMENT

4. Explain the choice of emission inputs used for the CALPUFF modeling given the variability of emissions among different sources at the site. Do the emissions represent an expected worst-case operating scenario? Please assist in tracking the emissions used in the CALPUFF modeling versus the permit application. It was also noted that several emission sources have zero emissions for all pollutants.

RESPONSE

The emissions represent an expected worst-case operating scenario. The maximum sustained emission rates were used for the corresponding averaging periods (1-hour, 3-hour, 8-hour, and 24-hour). For the annual averaging period, the annual average emission rates were used from all sources.

The assumptions that were used to determine the worst-case emission scenarios for the CALPUFF modeling analyses were described in the Appendix C of the Revised AFC application and are described below. It is true that several sources in the modeling analysis have zero emissions for all pollutants because of the following reasons:

The auxiliary boiler was exempted in the modeling analysis because the auxiliary boiler (AUX_BOIL) will not operate on the same day that the HRSG turbine (HRSGSTK) operates. In addition, the analysis assumed that all emissions from three gasifier refractory heaters (A, B, and C) are released to the gasifier warming vent stack B , since only one gasifier refractory heater will be operational at any given time. The analysis also assumed that all emissions from two emergency generators (1 and 2) are released to the emergency generator 1.

For the 24-hour analysis, it was assumed that the gasification flare operates for 24-hours of wet flaring. This is a cold gasification plant startup which is anticipated to occur only 1 time per year and last up to about 26 hours. However, the model conservatively assumed that a full 24-hours of this event happens everyday. During this same day, the CTG/HRSG cannot operate on syngas or co-firing because all of the off-spec syngas is being flared through gasification flare. Therefore, the CTG/HRSG worst case NOx emission for 24-hour averaging period cannot be the highest of natural gas, syngas, or co-firing. It can only be natural gas. During this same day, it was assumed that CTG/HRSG will have 1 cold startup (3 hours), 1 hot startup (1 hour), 1 cold shutdown (0.5 hour), 1 hot shutdown (0.5 hour), and normal operation during the rest of the hours (19 hours). The worst-case 24-hour PM_{10} emissions were based on the highest emission rate chosen from either (1) the combined emissions of 4 cold startup (12 hours), 4 shutdown (2 hours), and normal operation during the rest of the hours (10 hours) for natural gas scenario, or (2) the maximum hourly rate multiplied by 24 hours for syngas and co-firing scenarios. The combination of the worst-case NOx and PM_{10} emission rates were selected to be conservatively high, so that no impact could be underestimated.

SRU flare emissions for the 24-hour period were estimated based on 3 hours of startup/shutdown flaring with the remainder in pilot operation. Startup/shutdown flaring is anticipated to occur only 6 hours per year. However, the model conservatively assumed that a startup/shutdown flaring event happens everyday. Emergency generator and firewater pump will be operated for 50 hours per year and 100 hours per year, respectively. However, the model conservatively assumed that a full 24-hours of this event happens everyday.

The worst-case 1-hr emissions of NO_x, CO, and SO_2 are the maximum emission rates from either startup/shutdown or normal operation during any given one hour. The worst-case 3-hour

and 24-hour emissions of SO_2 consist of the maximum emission rate from normal operating scenarios (startup and shutdown SO_2 emissions will always be lower than normal operation SO_2 emissions). For annual analysis, the maximum emission rates of total annual emission rates for each fuel scenarios were used.

COMMENT

5. EPA released new guidance on August 31, 2009 regarding the recommended choices for input variables for CALMET. The HECA modeling deviates from these recommendations in many respects, although it is recognized that some of the HECA modeling files predate this EPA guidance. However, the revised HECA modeling report was completed in October 2009, which was after EPA released its CALMET guidance.

RESPONSE

HECA CALMET/CALPUFF modeling files were prepared before or at the time that EPA released a new guidance (*Clarification on EPA-FLM Recommended Setting for CALMET, August 2009*) although the final modeling report was prepared and dated October 2009. Also, URS prepared the CALMET files in accordance to guidance from the US Forest Service's consultant (June 2008).

The CALMET modeling files were prepared and completed in June, 2008. The PSD application was revised in June 2009 to account for the change in project site location. In October 2009, the PSD application was further revised primarily to remove the auxiliary turbine. Based on the October 2009 revised permit application, the revised CALPUFF modeling analysis were prepared and completed in July-September time frame in 2009.

COMMENT

6. Notwithstanding the above, the CALMET modeling still did not select certain regulatory defaults (i.e., IMIXH, ICOARE, THRESHL, ITWPROG). Please explain the choice of these variables for the CALMET modeling.

RESPONSE

The comment from Howard Gebhard on June 24, 2008 indicated that *"CALPUFF modeling options listed in the protocol appear to follow the standard "default" values, which follows FLM guidance. Any deviation from the "default" model; parameters should be justified by the applicant."* Any deviation from FLM guidance (*CALPUFF Reviewer's Guide, 2005*) is mentioned below. The CALMET analysis was conducted approximately 2 years ahead of the time that EPA guidance was released, and final CALPUFF analysis was conducted around the time that EPA guidance was released. Therefore, the analysis used default values defined in the FLM guidance, and any variables not defined in the FLM guidance followed by WRAP's BART analysis. Despite of it, any deviation from a new EPA guidance is also mentioned below:

(1) MREG – CALMET default is user defined. The analysis used the CALMET default values of IMIXH, ICOARE, and THRESHL that are associated with MREG=0, which are also consistent with WRAP analysis.

(2) IUTMZN (UT zone) – The analysis used 0 because the UTM was not used anyway. EPA-FLM recommended using -999, but it does not make any difference in modeling results.

(3) NZ (Number of vertical layers) and ZFACE (cell face heights in arbitrary vertical grid) – The analysis used NZ=11 because FLM guidance mentioned that the vertical grid will generally contain 9-12 layers, but did not specify the default value. With the user defined choice based on the FLM guidance, HECA used WRAP's choice, which was the representative modeling analysis in the region before EPA announced the new CALPUFF guidance on August 31, 2009. The analysis used 11 vertical layers with the maximum cell height as 5,000 meters. WRAP introduced Colorado Department of Public Health and Environment (CDPHE) analyses of soundings for summer ozone events in the Denver area. The CDPHE analysis suggests mixing heights in the Denver area are often well above the CALMET default value of 3,000 meters during the summer. A 3,000 m AGL maximum mixing height might be appropriate in the eastern U.S., however in the western U.S. in the summer mixing heights may exceed this value. WRAP expected that mixing heights in excess of the 3,000 m AGL CALMET default maximum would occur in the western States.

(4) IUVOUT, IWOUT, ITOUT, BIAS, NSMTH, NINTR2, FEXTR2, KBAR – since the analysis used NZ=11, these variables used 11 vertical layers.

(5) NOOBS – The analysis used NOOBS=1 because there were no valid upper air data available in the modeling domain.

(6) RMIN2 – Since FLM guidance did not have default value for this variable, the RMIN2=4 was used based on WRAP analysis.

(7) RMAX2 – The analysis used RMAX2=500 km based on FLM guidance.

(8) RMAX3 – Since FLM guidance did not have default value for this variable, the RMAX3=100 km was used based on WRAP analysis.

(9) TERRAD – Since FLM guidance did not have default value for this variable, the TERRAD=10 was used based on WRAP analysis.

(10) R2 – FLM guidance recommends R2 in the range of 100-200km. The analysis used R=200 km based on WRAP analysis, which is also within the FLM's range.

(11) IMIXH – The analysis used IMIXH=1 (Maul-Carson for land and water cells), which is consistent with CALMET recommended default and WRAP analysis.

(12) THRESHL –The analysis used the CALMET default value of 0.05, which is consistent with CALMET recommended default and WRAP analysis.

(13) ITWPROG – The analysis used option 2 (use prognostic lapse rates and prognostic delta T) instead of using option 0 (use SEA.DAT lapse rates and deltaT or assume neutral conditions if missing) because there were no SEA.DAT data available.

(14) ZIMAX and ZIMAXW – The analysis used the 4500 m of ZIMAX and ZIMAXW because the analysis used maximum cell height of 5000 meters (see item no. 3). ZIMAX and ZIMAXW should be equal or less than the highest cell face height. The value was consistent with WRAP analysis.

(15) ICOARE - The analysis used ICOARE=10 (COARE with no wave parameterization), which is consistent with CALMET recommended default and WRAP analysis.

(16) ITPROG – The analysis used ITPROG=1 because no upper air data were available in the modeling domain.

(17) JWAT1 and JWAT2 – One of the CALMET problems found in EPA-approved CALMET version, which was publicly reported in *Model Change Bulletins (MCB)-E* (June 13, 2008, TRC) is that *"no vertical extrapolation of temperature from lowest 3D.DAT level to lower CALMET levels was performed overwater when ITWPROG=2".* The model did not run through if the JWAT1 and JWAT2 set to 55 when the analysis used ITWPROG=2 (use prognostic lapse rates and prognostic delta T) and NOOBS=1 (use surface stations; and use MM5/3D for upper air data) because it requires SEA.DAT for land/water interpolation. WRAP was able use JWAT1 and JWAT2 equal to 55 because they used NOOBS=2 (no surface or upper air observations; use MM5/3D for surface and upper air data) while they used ITWPROG=2. Therefore, the analysis used the user defined 999 values for JWAT1 and JWAT2 in order to make the model run through.

Since the model-predicted concentrations are very low compared to the corresponding thresholds, it is expected that the changes to the regulatory option of these variables would not make significant differences in modeling results.

COMMENT

7. Also, in CALPUFF, the SVMIN variable does not appear to match the regulatory default. Please explain.

RESPONSE

The CALPUFF default SVMIN is 0.5 for land and 0.37 for water. The analysis used CALPUFF default SVMIN values, which are also consistent with WRAP analysis.

COMMENT

8. The CALMET/CALPUFF modeling selected the NAS-C datum over the WGS-84 datum. Although this variable is "user defined", WGS-84 is the normal choice for most CALPUFF modeling. Please explain why the user selected NAS-C for this particular modeling study.

RESPONSE

It is considered to be more accurate to use the coordinate of NAS-C (North America) rather than WGS-84 (global coverage) since the modeling domain is limited to the North American regional area rather than whole earth. Consequently, NAS-C data were selected.

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COMMENT

9. The inputs for particle size appear to have been applied to the secondary organic aerosol (SOA) fraction of the PM-10 emissions. Please explain the technical basis for the particle size data and explain why only the SOA emissions were separated by particle size.

RESPONSE

The particle size data were obtained from National Park Service's Particulate Matter Speciation (http://www.nature.nps.gov/air/permits/ect/index.cfm) for "Gas-fired Combustion Turbines". This particle size distribution method was applied to the CTG/HRSG. The particulate matter was divided into multiple categories based on its size: PM_{10}, $PM_{0.05}$, $PM_{0.1}$, $PM_{0.15}$, $PM_{0.2}$, $PM_{0.25}$, PM_1, and elemental carbon (EC). For the smaller particulate matter, which has diameter equal to or less than 1 µm ($PM_{0.05}$, $PM_{0.1}$, $PM_{0.15}$, $PM_{0.2}$, $PM_{0.25}$, and PM_1), I grouped these fine PMs as secondary organic aerosol (SOA). The model used the light extinction efficiency of organic carbon (EEOC=4) for these fine PMs (grouped as SOA), which is more conservative extinction efficiency than the one for the fine PMs (EEPMF=1) regarding visibility impairment impact analysis.

COMMENT

10. In CALPOST, why was only Method 2 evaluated for visibility impacts? Using Method 2 is consistent with the DRAFT 2008 FLAG guidance, but this guidance has not yet been adopted in final form.

RESPONSE

The analysis used Method 2 (MVISBK=2), which is the preferred method in the DRAFT CALPUFF Reviewer's Guide (September, 2005) and the new EPA guidance (August, 2009). Based on a phone conversation with the FLM on March 30, 2010, a Method 2 analysis is an acceptable method to evaluate the visibility impact.

COMMENT

11. Except for the HRSGSTK emission source, all PM-10 emissions were modeled in the visibility assessment as PMC. This implies that none of the PM-10 emissions from sources other than HRSGSTK are PM-2.5 or smaller. Please explain/justify this assumption.

RESPONSE

The HRSG turbine (HRSGSTK) is operated on natural gas, syngas or a combination; therefore, it is assumed that all particulate matter emissions from the CTG/HRSG are smaller than $PM_{2.5}$ based on National Park Service (NPS)'s Particulate Matter Speciation (PMS) for "Gas-fired Combustion Turbines" (http://www.nature.nps.gov/air/permits/ect/index.cfm). For other sources such as cooling towers, vents, flares, and dust collectors, the sources are likely to emit significantly more coarse particulate matter (PM_{10}) than fine particulate matter ($PM_{2.5}$). The emergency generators and fire water pump engine combust diesel fuel; therefore, all particulate matter emitted from these sources were assumed to be PM_{10}. Although some smaller particulate matter may be emitted from the thermal oxidizer and gasifier refractory heaters, these sources emit less than 1 percent of total project emissions and the speciation was unknown, thus all PM emissions from these sources were set to PM_{10}. Therefore, particulate matter emissions from all sources except CTG/HRSG were modeled as PM_{10} (PMC in the visibility assessment).

In addition, the CTG/HRSG is the largest PM emission source followed by the cooling towers, the remainder of the sources emit less than 6 percent of total project PM emissions, therefore, no noticeable changes in PM increment or visibility impact are expected by changing this small portion of PM_{10} to fine particulate matter.

WORKSHOP REQUEST

36. Please revise Table 57-1 from the Applicant's Responses to the CEC Data Requests Set One No. 57 to provide the missing information.

RESPONSE

Operational emissions from stationary sources are presumed to conform to the Clean Air Act and the State Implementation Plan because they are subject to PSD/New Source Review (NSR) requirements and permitting (40 Code of Federal Regulations [CFR] 93.153[d][1]; 40 CFR 51.853[d][1]). Other emissions that are not subject to PSD/NSR requirements such as total construction emissions and mobile operational emissions are compared to the GCR de minimis thresholds and are presented in Revised Table 57-1.

As stated in the response to CEC Set One Data Request No. 57, two construction periods were considered: the 12-month period spanning Months 1 through 12 when the majority of earthmoving would take place, and the 12-month period spanning Months 17 through 28, when the maximum amount of construction equipment would be on site. Onsite construction takes place in both construction periods, but offsite construction (offsite linears) only takes place from Months 1 through 12. Emissions from onsite and offsite personal vehicles and delivery trucks during the two construction periods are also included in the table.

Both onsite and offsite mobile operational emissions are shown in Revised Table 57-1. Onsite mobile operational emissions include emissions from onsite coal and gasifier trucks plus the operations and maintenance trucks described in the responses to CEC Set One Data Requests Nos. 23 and 24, while offsite mobile operational emissions cover net increase in emissions in the San Joaquin Valley Air Basin (SJVAB) from trucks and rail.

On May 5, 2010, the U.S. EPA published a final rule redesignating the area as an extreme ozone nonattainment area, effective June 4, 2010. As shown in bold font in Revised Table 57-1, during both construction periods, emissions of both nitrogen oxides and reactive organic gases would exceed the de minimis threshold of 10 tons per year for an extreme ozone nonattainment area, making GCR applicable to the Project emissions during construction. None of the mobile source emissions during operations would exceed the de minimis thresholds. The Applicant will surrender Emission Reduction Credits prior to start of construction to account for emissions above the GCR de minimis thresholds.

The SJVAB is a maintenance area for the federal PM_{10} standard. Construction period PM_{10} emissions and operational mobile PM_{10} emissions would not exceed the GCR de minimis level of 100 tons per year for PM_{10}. Entrained fugitive road dust emissions from unpaved roads presented in Revised Table 57-1 use the SCAQMD emission factors, although the response to Workshop Request 24 above presents these emissions also using AP-42 emission factors. However, even if the fugitive dust emissions were changed based on the AP-42 emission factors, the PM_{10} emissions would be below the GCR de minimis thresholds. The total PM_{10} emissions using AP-42 emission factors for Months 1 through 12 would be 67.53 tons per year, and the total PM_{10} emissions for Months 17 through 28 would be 94.53 tons per year.

Emission calculations supporting this response are presented in Revised Attachments 57-1 and 3-1.

Revised Table 57-1
Summary of Construction Emissions and Mobile Source Emissions During Operation Within the San Joaquin Valley Air Basin

Construction Emissions	CO (tons/year)	NO_X (tons/year)	PM_{10} (tons/year)	ROG (tons/year)
Months 1 – 12				
Onsite Exhaust	16.10	31.17	1.92	4.79
Onsite Fugitive Dust			9.21	
Offsite Exhaust	27.38	32.18	2.13	8.92
Offsite Fugitive Dust			50.68	
Total	**43.48**	**63.34**	**63.93**	**13.71**
GCR De Minimis Levels	**NA**	**10**	**100**	**10**
Months 17 – 28				
Onsite Exhaust	21.11	40.85	2.31	6.04
Onsite Fugitive Dust			6.05	
Offsite Exhaust	82.27	31.90	2.46	12.28
Offsite Fugitive Dust			74.47	
Total	**103.37**	**72.74**	**85.29**	**18.33**
GCR De Minimis Levels	**NA**	**10**	**100**	**10**
Mobile Source Emissions During Operation Within the SJVAB	**CO (tons/year)**	**NO_X (tons/year)**	**PM_{10} (tons/year)**	**ROG (tons/year)**
Onsite Trucks	0.35	0.83	0.02	0.10
Offsite Trucks and Rail (Net Increase)	3.69	6.54	0.37	0.76
Total	**4.04**	**7.37**	**0.39**	**0.85**
GCR De Minimis Levels	**NA**	**10**	**100**	**10**

Notes:

(1) Onsite construction emissions include emissions from construction equipment, construction trucks, personal vehicles, and delivery trucks traveling onsite on unpaved and paved roads.

(2) Offsite construction emissions include emissions from construction equipment, construction trucks (offsite linears), personal vehicles, and delivery truck traveling offsite. Offsite linears construction only takes place in Months 1 through 12, but offsite personal vehicles and delivery trucks take place in Months 1 through 12 and Months 17 through 28.

(3) All construction equipment assumes an annual 66 percent load factor

(4) Operational offsite truck and rail net increase emissions are from Table 5.1-26 in the Revised AFC and represent the difference in mobile source emissions in the SJVAB between the Project Scenario and the current transportation. Operational onsite truck emissions are based on onsite trucks moving coal and gasification solids.

(5) The GCR NO_X and ROG de minimis levels are for extreme ozone nonattainment areas.

(6) The GCR PM_{10} de minimis level is for PM_{10} moderate nonattainment or maintenance areas.

(7) Bold values indicate emissions are above the GCR de minimis level.

CO = carbon monoxide
GCR = General Conformity Rule
NA = Not Applicable
NO_X = nitrogen oxides
PM_{10} = particulate matter less than or equal to 10 microns
ROG = reactive organic gases
SJVAB = San Joaquin Valley Air Basin

REVISED ATTACHMENT 57-1

ATTACHMENT 57-1

Construction: Months 1-12

Activity	CO tons/yr	NOX tons/yr	PM10 tons/yr	ROG tons/yr
On-Site Construction Emissions				
On-Site Combustion Emissions				
Construction Equipment & Construction Trucks (Concrete, Dump Trucks, Flatbed Trucks, …)	14.99	29.75	1.83	4.39
Worker Vehicles	0.51	0.04	0.01	0.04
Delivery Trucks	0.59	1.38	0.08	0.36
Subtotal of On-site Combustion Emissions	**16.10**	**31.17**	**1.92**	**4.79**
On-Site Fugitive Dust Emissions				
Construction Equipment & Construction Trucks (Concrete, Dump Trucks, Flatbed Trucks, …)			6.63	
Worker Vehicles			0.21	
Delivery Trucks			2.36	
Subtotal of On-Site Fugitive Dust Emissions			**9.21**	
Off-Site On-Highway Emissions				
Off-Site Combustion Emissions				
Construction Trucks (Concrete, Dump Trucks, Flatbed Trucks, …)	2.95	4.91	0.37	1.06
Worker Vehicles	13.19	1.06	0.16	1.01
Delivery Trucks	11.24	26.21	1.59	6.85
Subtotal of Off-Site Combustion Emissions	**27.38**	**32.18**	**2.13**	**8.92**
Off-Site Fugitive Dust Emissions				
Construction Trucks (Concrete, Dump Trucks, Flatbed Trucks, …)			0.31	
Worker Vehicles			5.50	
Delivery Trucks			44.87	
Subtotal of Off-Site Fugitive Dust Emissions			**50.68**	

Contruction: Months 17-28

Activity	CO tons/yr	NOX tons/yr	PM10 tons/yr	ROG tons/yr
On-Site Construction Emissions				
On-Site Combustion Emissions				
Construction Equipment & Construction Trucks (Concrete, Dump Trucks, Flatbed Trucks, …)	17.75	39.25	2.19	5.47
Worker Vehicles	2.77	0.22	0.03	0.21
Delivery Trucks	0.59	1.38	0.08	0.36
Subtotal of On-site Combustion Emissions	**21.11**	**40.85**	**2.31**	**6.04**
On-Site Fugitive Dust Emissions				
Construction Equipment & Construction Trucks (Concrete, Dump Trucks, Flatbed Trucks, …)			2.53	
Worker Vehicles			1.15	
Delivery Trucks			2.36	
Subtotal of On-Site Fugitive Dust Emissions			**6.05**	
Off-Site On-Highway Emissions				
Off-Site Combustion Emissions				
Worker Vehicles	71.02	5.69	0.87	5.44
Delivery Trucks	11.24	26.21	1.59	6.85
Subtotal of Off-Site Combustion Emissions	**82.27**	**31.90**	**2.46**	**12.28**
Off-Site Fugitive Dust Emissions				
Worker Vehicles			29.60	
Delivery Trucks			44.87	
Subtotal of Off-Site Fugitive Dust Emissions			**74.47**	

ATTACHMENT 57-1

Operational

Activity	CO tons/yr	NOX tons/yr	PM10 tons/yr	ROG tons/yr
Onsite Mobile Operational Emissions				
Onsite Light Duty Trucks	0.01	0.01	0.01	0.00
Onsite Heavy Duty Trucks (Coal and Solid Trucks)	0.34	0.82	0.01	0.10
Subtotal of On-site Emissions	**0.35**	**0.83**	**0.02**	**0.10**
Offsite Mobile Operational Emissions				
Truck and Rail	3.69	6.54	0.37	0.76
Subtotal of Off-Site Emissions	**3.69**	**6.54**	**0.37**	**0.76**

Hydrogen Energy California, Kern County Power Project
Unmitigated Annual Exhaust Emissions For HECA Onsite Construction
5/12/2010

	CO		CO_2		CH_4		N_2O		NO_2		PM_{10}		$PM_{2.5}$		SO_2		ROG[1]		CO_2e	
Month	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)
1	2.72	NA	505.12	NA	0.0554	NA	0.0095	NA	5.69	NA	0.295	NA	0.271	NA	0.0051	NA	0.711	NA	509.23	NA
2	2.75	NA	512.80	NA	0.0556	NA	0.0096	NA	5.77	NA	0.300	NA	0.275	NA	0.0052	NA	0.728	NA	516.95	NA
3	2.56	NA	464.12	NA	0.0527	NA	0.0089	NA	5.25	NA	0.292	NA	0.267	NA	0.0048	NA	0.696	NA	467.99	NA
4	2.58	NA	469.29	NA	0.0529	NA	0.0090	NA	5.29	NA	0.297	NA	0.273	NA	0.0048	NA	0.713	NA	473.20	NA
5	1.57	NA	272.82	NA	0.0309	NA	0.0055	NA	3.06	NA	0.207	NA	0.190	NA	0.0029	NA	0.484	NA	275.17	NA
6	1.57	NA	274.27	NA	0.0311	NA	0.0055	NA	3.07	NA	0.208	NA	0.190	NA	0.0029	NA	0.486	NA	276.63	NA
7	1.61	NA	279.79	NA	0.0323	NA	0.0057	NA	3.14	NA	0.215	NA	0.197	NA	0.0030	NA	0.499	NA	282.22	NA
8	1.53	NA	263.48	NA	0.0311	NA	0.0055	NA	2.93	NA	0.197	NA	0.180	NA	0.0028	NA	0.471	NA	265.82	NA
9	1.46	NA	252.28	NA	0.0296	NA	0.0053	NA	2.77	NA	0.184	NA	0.169	NA	0.0027	NA	0.454	NA	254.54	NA
10	1.44	NA	240.31	NA	0.0301	NA	0.0051	NA	2.68	NA	0.192	NA	0.176	NA	0.0026	NA	0.460	NA	242.53	NA
11	1.45	NA	236.66	NA	0.0317	NA	0.0051	NA	2.61	NA	0.188	NA	0.172	NA	0.0026	NA	0.463	NA	238.90	NA
12	1.47	22.71	252.77	4,023.69	0.0336	0.467	0.0057	0.0804	2.81	45.07	0.196	2.772	0.180	2.539	0.0028	0.0422	0.484	6.651	255.24	4,058.42
13	1.44	21.44	264.22	3,782.79	0.0338	0.445	0.0061	0.0769	2.91	42.29	0.186	2.663	0.171	2.440	0.0029	0.0400	0.471	6.411	266.81	3,816.00
14	1.64	20.33	291.22	3,561.22	0.0394	0.429	0.0068	0.0741	3.26	39.78	0.216	2.579	0.198	2.362	0.0032	0.0380	0.533	6.217	294.16	3,593.21
15	1.65	19.42	297.44	3,394.55	0.0401	0.417	0.0071	0.0723	3.34	37.87	0.218	2.506	0.200	2.295	0.0033	0.0365	0.541	6.062	300.49	3,425.71
16	1.63	18.47	293.07	3,218.32	0.0400	0.404	0.0070	0.0703	3.32	35.89	0.217	2.426	0.199	2.222	0.0033	0.0350	0.525	5.874	296.09	3,248.60
17	1.79	18.69	324.56	3,270.07	0.0445	0.417	0.0079	0.0728	3.67	36.50	0.235	2.453	0.215	2.247	0.0036	0.0357	0.574	5.964	327.96	3,301.39
18	1.76	18.87	316.89	3,312.69	0.0443	0.431	0.0078	0.0751	3.59	37.03	0.230	2.476	0.211	2.268	0.0035	0.0363	0.558	6.035	320.24	3,345.00
19	1.89	19.15	345.53	3,378.43	0.0475	0.446	0.0087	0.0781	3.90	37.79	0.244	2.505	0.224	2.296	0.0038	0.0372	0.593	6.129	349.21	3,411.99
20	2.46	20.07	491.21	3,606.17	0.0616	0.476	0.0127	0.0853	5.47	40.34	0.304	2.6122	0.279	2.395	0.0053	0.0397	0.750	6.407	496.44	3,642.61
21 max short-term	2.67	21.29	545.60	3,899.49	0.0670	0.514	0.0143	0.0943	6.05	43.61	0.327	2.755	0.300	2.526	0.0058	0.0428	0.809	6.762	551.43	3,939.50
22	2.41	22.26	490.16	4,149.33	0.0609	0.545	0.0129	0.1020	5.43	46.36	0.293	2.855	0.269	2.619	0.0053	0.0455	0.727	7.029	495.43	4,192.40
23	2.45	23.26	501.39	4,414.07	0.0627	0.576	0.0132	0.1101	5.55	49.31	0.296	2.964	0.272	2.719	0.0054	0.0483	0.746	7.312	506.79	4,460.29
24	2.45	24.24	502.63	4,663.93	0.0630	0.605	0.0132	0.1176	5.57	52.06	0.297	3.065	0.273	2.812	0.0054	0.0509	0.749	7.577	508.05	4,713.10
25	2.46	25.26	503.87	4,903.58	0.0632	0.634	0.0132	0.1248	5.58	54.73	0.298	3.176	0.274	2.916	0.0054	0.0534	0.752	7.858	509.31	4,955.59
26	2.46	26.07	503.87	5,116.23	0.0632	0.658	0.0132	0.1312	5.58	57.05	0.298	3.259	0.274	2.992	0.0054	0.0556	0.752	8.077	509.31	5,170.74
27	2.25	26.67	459.51	5,278.30	0.0577	0.676	0.0120	0.1361	5.07	58.78	0.271	3.311	0.249	3.040	0.0050	0.0573	0.691	8.227	464.44	5,334.69
28 max 12 month period	1.85	26.89	359.50	5,344.73	0.0480	0.684	0.0092	0.1383	4.00	59.47	0.230	3.324	0.211	3.052	0.0040	0.0580	0.584	8.285	363.37	5,401.96
29	1.68	26.78	323.92	5,344.09	0.0426	0.682	0.0082	0.1386	3.59	59.39	0.210	3.299	0.193	3.029	0.0036	0.0579	0.523	8.234	327.36	5,401.36
30	1.61	26.63	308.21	5,335.42	0.0401	0.677	0.0078	0.1386	3.41	59.21	0.201	3.269	0.184	3.002	0.0034	0.0577	0.496	8.172	311.48	5,392.61
31	1.61	26.35	308.21	5,298.10	0.0401	0.670	0.0078	0.1378	3.41	58.72	0.201	3.226	0.184	2.962	0.0034	0.0573	0.496	8.075	311.48	5,354.87
32	1.49	25.38	276.07	5,082.95	0.0369	0.645	0.0069	0.1320	3.06	56.31	0.188	3.109	0.172	2.855	0.0030	0.0550	0.460	7.786	278.98	5,137.42
33	1.38	24.09	259.50	4,796.85	0.0339	0.612	0.0065	0.1242	2.88	53.15	0.176	2.959	0.162	2.717	0.0028	0.0520	0.428	7.404	262.23	4,848.22
34	1.16	22.83	206.99	4,513.68	0.0274	0.579	0.0050	0.1164	2.29	50.01	0.148	2.814	0.136	2.583	0.0023	0.0490	0.355	7.032	209.13	4,561.92
35	0.89	21.27	168.63	4,180.92	0.020	0.536	0.0041	0.1073	1.78	46.24	0.106	2.624	0.097	2.408	0.0018	0.0454	0.273	6.559	170.31	4,225.45
36	0.76	19.59	148.74	3,827.03	0.017	0.491	0.0037	0.0978	1.56	42.23	0.092	2.418	0.084	2.220	0.0016	0.0416	0.230	6.040	150.25	3,867.65
37	0.56	17.68	97.71	3,420.87	0.013	0.440	0.0024	0.0869	1.04	37.70	0.068	2.188	0.062	2.008	0.0011	0.0373	0.161	5.449	98.72	3,457.06
38	0.30	15.52	51.34	2,968.34	0.006	0.382	0.0011	0.0748	0.51	32.63	0.037	1.927	0.034	1.768	0.0006	0.0324	0.086	4.782	51.81	2,999.57
39	0.29	13.56	50.10	2,558.93	0.006	0.330	0.0011	0.0639	0.50	28.06	0.037	1.693	0.033	1.553	0.0005	0.0280	0.083	4.174	50.55	2,585.68
40	0.28	12.00	48.65	2,248.07	0.005	0.288	0.0011	0.0558	0.49	24.54	0.036	1.499	0.033	1.375	0.0005	0.0245	0.081	3.671	49.09	2,271.40
41	0.25	10.57	40.97	1,965.12	0.005	0.250	0.0009	0.0485	0.41	21.36	0.031	1.321	0.028	1.211	0.0004	0.0214	0.064	3.212	41.37	1,985.41
42	0.25	9.21	40.97	1,697.88	0.005	0.215	0.0009	0.0416	0.41	18.35	0.031	1.151	0.028	1.055	0.0004	0.0185	0.064	2.781	41.37	1,715.30
43	0.24	7.85	39.52	1,429.18	0.005	0.180	0.0009	0.0347	0.40	15.34	0.030	0.980	0.028	0.898	0.0004	0.0156	0.062	2.347	39.90	1,443.72
44	0.21	6.57	36.15	1,189.26	0.004	0.147	0.0008	0.0286	0.36	12.64	0.027	0.820	0.025	0.751	0.0004	0.0129	0.049	1.936	36.49	1,201.23
Maximum (100 % load)	**2.75**	**26.89**	**545.60**	**5,344.73**	**0.0670**	**0.684**	**0.0143**	**0.1386**	**6.05**	**59.47**	**0.327**	**3.324**	**0.300**	**3.052**	**0.0058**	**0.0580**	**0.809**	**8.285**	**551.43**	**5,401.96**
Average (66 % load)	**1.82**	**17.75**	**360.10**	**3,527.52**	**0.04**	**0.451**	**0.0094**	**0.0915**	**3.99**	**39.25**	**0.216**	**2.194**	**0.198**	**2.014**	**0.0039**	**0.04**	**0.534**	**5.468**	**363.94**	**3,565.30**
	68.92		**12,920.05**		**1.61**		**0.31**		**143.48**		**8.55**		**7.84**		**0.14**		**20.92**		**13,048.47**	

Note:
[1] Assuming ROGs are equivalent to VOCs
- Assuming 75% operational average load

Months 17-28

MODEL INPUTS	NO2	PM10	PM2.5	SO2	
Max annual value (tons)	39.25	2.194	2.014	0.04	hours per year 8760
Max annual value (pounds)	78494.3	4387.3	4028.5	76.5	
Max annual emission rate (lb/hr)	8.96	0.50	0.46	0.0087	

Months 1-12

MODEL INPUTS	NO2	PM10	PM2.5	SO2
Max annual value (tons)	29.75	1.829	1.676	0.03
Max annual value (pounds)	59492.4	3658.7	3351.9	55.7
Max annual emission rate (lb/hr)	6.79	0.42	0.38	0.0064

EMISSION FACTOR FOR ONROAD VEHICLES

Onroad Vehicle	Fuel Type	Daily Vehicle Count	Vehicle Type	EF (lbs/mile)									
				TOC	CO	NOx	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
Personal Commuting Vehicles	G/D	1140	LDA/ LDT	0.0012	0.0154	0.0012	0.0002	2.43E-05	0.0001	2.57E+00	9.55E-05	1.90E-04	2.604
Light delivery truck (e.g. Fed-Ex)	D	10	LHDT	0.0011	0.0073	0.0174	0.0003	1.10E-05	0.0003	1.16E+00	6.61E-05	2.20E-05	1.178
Heavy delivery truck (e.g. flat beds carrying construction eqp)	D	50	HHDT	0.0271	0.0434	0.1010	0.0063	8.16E-05	0.0057	8.48E+00	1.10E-04	1.76E-04	8.515

Onsite distance measured from draft plot plan for worker vehicles
Emission factors from EMFAC2007 (version 2.3) for year 2010
Emission factors for personal commuting vehicles are based on the assumption 50% LDA and 50% LDT
CH_4 and N_2O emission factor for personal commuting vehicles is based on the average factor for gasoline and diesel passenger vehicles from CCAR, GRP Version 3.0, Table C.5
CH_4 and N_2O emission factor for light delivery trucks is based on the factor for diesel light duty trucks from CCAR, GRP Version 3.0, Table C.5
CH_4 and N_2O emission factor for heavy duty tucks is based on the factor for diesel heavy duty trucks from CCAR, GRP Version 3.0, Table C.5

EMISSION CALCULATION FOR ONROAD VEHICLES **ONSITE**

Maximum Daily Emissions

		Round Trip Distance (miles/day vehicle)	Daily Total VMT	Daily Emissions (lbs/day)									
				TOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
Highway Vehicles													
Personal Commuting Vehicles		1.5	1,710	2.0	26.3	2.1	0.3	0.0	0.3	4,396.1	0.2	0.3	4,453.6
Light delivery truck (e.g. Fed-Ex)		2	20	0.0	0.1	0.3	0.0	0.0	0.0	23.1	0.0	0.0	23.6
Heavy delivery truck (e.g. flat beds carrying construction eqp)		2	100	2.7	4.3	10.1	0.6	0.0	0.6	847.7	0.0	0.0	851.5

Annual Emission Months 1-12

	Total Op. Days / Period [1]	Round Trip Distance (miles/day vehicle)	Annual Total VMT	Annual Emission Rate (tons/year)									
				TOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
Highway Vehicles	**Total Days**												
Personal Commuting Vehicles	22	1.5	66,914	0.0	0.5	0.0	0.0	0.0	0.0	86.0	0.0	0.0	87.1
Light delivery truck (e.g. Fed-Ex)	264	2	5,280	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	3.1
Heavy delivery truck (e.g. flat beds carrying construction eqp)	264	2	26,400	0.4	0.6	1.3	0.1	0.0	0.1	111.9	0.0	0.0	112.4

Annual Emission Months 17-28

	Total Op. Days / Period [1]	Round Trip Distance (miles/day vehicle)	Annual Total VMT	Annual Emission Rate (tons/year)									
				TOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
Highway Vehicles	**Total Days**												
Personal Commuting Vehicles	22	1.5	360,335	0.2	2.8	0.2	0.0	0.0	0.0	463.2	0.0	0.0	469.2
Light delivery truck (e.g. Fed-Ex)	264	2	5,280	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	3.1
Heavy delivery truck (e.g. flat beds carrying construction eqp)	264	2	26,400	0.4	0.6	1.3	0.1	0.0	0.1	111.9	0.0	0.0	112.4

Notes:
(1) The period for personal commuting vehicles is 22 days per month
(2) grams to pounds conversion = 0.002204586

FUGITIVE EMISSION FACTOR FOR ONROAD VEHICLES **ONSITE**

0.0064 PM10 lb/VMT for passenger vehicle (from SCAQMD CEQA Handbook Table A9-9-B-1 for major streets/highways)
0.1491 PM10 lb/VMT for trucks (from SQAMQD CEQA Handbook Table A9-9-C-1 for major streets/highways)
0.1690 PM2.5 fraction of PM10 (from SQAMQD CEQA Handbook Appendix A - CEIDARS Table)

Onroad Vehicle Fugitive	Daily PM10 Emissions (lb/day)	Annual PM10 Emissions (tons/yr) Mos. 1-12	Annual PM10 Emissions (tons/yr) Mos. 17-28	Daily PM2.5 Emissions (lb/day)	Annual PM2.5 Emissions (tons/yr) Mos. 1-12	Annual PM2.5 Emissions (tons/yr) Mos. 17-28
Personal Commuting Vehicles	10.9	0.2	1.2	1.85	0.04	0.19
Light delivery truck (e.g. Fed-Ex)	3.0	0.4	0.4	0.50	0.07	0.07
Heavy delivery truck (e.g. flat beds carrying construction eqp)	14.9	2.0	2.0	2.52	0.33	0.33
Total	**28.8**	**2.6**	**3.5**	**4.9**	**0.4**	**0.6**

GHG EMISSION CALCULATIONS FOR ENTIRE CONSTRUCTION PERIOD **ONSITE**

1 short ton = 0.90718474 metric tonnes

	CO_2 (tonnes/period)	N_2O (tonnes/period)	CH_4 (tonnes/period)	CO_2e (tonnes/period)
Personal Commuting Vehicles	963.5	0.0	0.1	976.0
Light delivery truck (e.g. Fed-Ex)	10.2	0.0	0.0	10.3
Heavy delivery truck (e.g. flat beds carrying construction eqp)	372.2	0.0	0.0	373.9
Total	**1,345.8**	**0.0**	**0.1**	**1,360.3**

EMISSION CALCULATION FOR ONROAD VEHICLES **OFFSITE**

Maximum Daily Emissions

		Round Trip Distance (miles/day vehicle)	Daily Total VMT	Daily Emissions (lbs/day)									
				TOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
Personal Commuting Vehicles		38.5	43,890	51.6	674.1	54.0	8.3	1.1	6.4	112,833.2	4.2	8.3	114,307.8
Light delivery truck (e.g. Fed-Ex)		38	380	0.4	2.8	6.6	0.1	0.0	0.1	439.6	0.0	0.0	447.6
Heavy delivery truck (e.g. flat beds carrying construction eqp)		38	1,900	51.4	82.4	191.9	11.9	0.2	10.8	16,107.1	0.2	0.3	16,179.1

Annual Emission Months 1-12

Onroad Vehicle Combustion	Total Op. Days / Period [1]	Round Trip Distance (miles/day vehicle)	Annual Total VMT	Annual Emission Rate (tons/year)									
				TOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
	Total Days												
Personal Commuting Vehicles	22	38.5	1,717,455.4	1.0	13.2	1.1	0.2	0.0	0.1	2,207.6	0.1	0.2	2,236.5
Light delivery truck (e.g. Fed-Ex)	264	38	100,320.0	0.1	0.4	0.9	0.0	0.0	0.0	58.0	0.0	0.0	59.1
Heavy delivery truck (e.g. flat beds carrying construction eqp)	264	38	501,600.0	6.8	10.9	25.3	1.6	0.0	1.4	2,126.1	0.0	0.0	2,135.6

Annual Emission Months 17-28

Onroad Vehicle Combustion	Total Op. Days / Period [1]	Round Trip Distance (miles/day vehicle)	Annual Total VMT	Annual Emission Rate (tons/year)									
				TOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$	CO_2	N_2O	CH_4	CO_2e
	Total Days												
Personal Commuting Vehicles	22	38.5	9,248,588.5	5.4	71.0	5.7	0.9	0.1	0.7	11,888.2	0.4	0.9	12,043.6
Light delivery truck (e.g. Fed-Ex)	264	38	100,320.0	0.1	0.4	0.9	0.0	0.0	0.0	58.0	0.0	0.0	59.1
Heavy delivery truck (e.g. flat beds carrying construction eqp)	264	38	501,600.0	6.8	10.9	25.3	1.6	0.0	1.4	2,126.1	0.0	0.0	2,135.6

Notes:
(1) The period for personal commuting vehicles is 22 days per month

FUGITIVE EMISSION FACTOR FOR ONROAD VEHICLES **OFFSITE**

Onroad Vehicle Fugitive	Daily PM10 Emissions (lb/day)	Annual PM10 Emissions (tons/yr) Mos. 1-12	Annual PM10 Emissions (tons/yr) Mos. 17-28	Daily PM2.5 Emissions (lb/day)	Annual PM2.5 Emissions (tons/yr) Mos. 1-12	Annual PM2.5 Emissions (tons/yr) Mos. 17-28
Personal Commuting Vehicles	280.9	5.5	29.6	47.5	0.9	5.0
Light delivery truck (e.g. Fed-Ex)	56.7	7.5	7.5	9.6	1.3	1.3
Heavy delivery truck (e.g. flat beds carrying construction eqp)	283.3	37.4	37.4	47.9	6.3	6.3
Total	**620.8**	**50.4**	**74.5**	**104.9**	**8.5**	**12.6**

Assumptions:
Assumed average distance traveled off site for all employees commuting will be 20 miles
times 2 for return trip = 40 miles
22 days per month of construction, average

GHG EMISSION CALCULATIONS FOR ENTIRE CONSTRUCTION PERIOD **OFFSITE**

1 short ton = 0.90718474 metric tonnes

	CO_2 (tonnes/period)	N_2O (tonnes/period)	CH_4 (tonnes/period)	CO_2e (tonnes/period)
Personal Commuting Vehicles	24,728.7	0.9	1.8	25,051.9
Light delivery truck (e.g. Fed-Ex)	193.0	0.0	0.0	196.5
Heavy delivery truck (e.g. flat beds carrying construction eqp)	7,072.3	0.1	0.1	7,103.9
Total	**31,994.0**	**1.0**	**2.0**	**32,352.3**

Month	Number of Worker/ Day	Avg Daily Vehicles/ Day
1	44	34
2	64	49
3	68	52
4	65	50
5	120	92
6	122	94
7	141	108
8	286	220
9	400	308
10	390	300
11	464	357
12	472	363
13	502	386
14	490	377
15	433	333
16	442	340
17	613	472
18	672	517
19	782	602
20	884	680
21	1286	989
22	1421	1093
23	1421	1093
24	1482	1140
25	1466	1128
26	1390	1069
27	1356	1043
28	1422	1094
29	1377	1059
30	1382	1063
31	1442	1109
32	1447	1113
33	1382	1063
34	1211	932
35	1145	881
36	966	743
37	845	650
38	665	512
39	550	423
40	462	355
41	457	352
42	137	105
43	128	98
44	254	195

- Actual worker schedule data from Table 2-25, Estimated Monthly Construction Workforce from AFC

Number of workers per commuter vehicle = 1.3

Vehicle occupancy rate is based on information from Section 2.0 Project Description, page 2-83

CO_2 GWP (SAR, 1996) = 1

CH_4 GWP (SAR, 1996) = 21

N_2O GWP (SAR, 1996) = 310

Annual Fugitive Dust Emissions

Maximum annual fugitive dust activity occurs in months 1-12.

7 months of soil disturbance
10 total construction hours per work day
22 construction days per month
60% average load factor for equipment listed (CEQA)

Grading Emissions Factor **To be used for all scraping and grading activities (except material handling)**

$E = 0.051(S)^{2.0}$ multiply by 0.60 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
assumed to be 4 mph S = mean vehicle speed (mph) USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

$E = 0.040(S)^{2.5}$ multiply by 0.031 for $PM_{2.5}$
assumed to be 4 mph S = mean vehicle speed (mph)

S = 4.0 mph
1.28 lb ≤ 30 µm/VMT
0.82 lb ≤ 15 µm/VMT
PM_{10} = 0.49 lb PM_{10}/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

Equipment	Quantity	Hours/Day	Annual VMT	Watering Control Efficiency	PM10 Emissions (lb/yr)	PM10 Emissions (ton/yr)	PM2.5 Emissions (lb/yr)	PM2.5 Emissions (ton/yr)
Scraper	24	6	634	67%	102	0.05	8.3	0.00
Grader	14	6	3,696	67%	597	0.30	48.4	0.02
				Total	**700**	**0.35**	**56.7**	**0.03**

Bulldozing/Earth clearing

$E = 1.0(s)^{1.2}/(M)^{1.4}$ multiply by 0.75 for PM_{10} USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 5.7(s)^{1.2}/(M)^{1.3}$ multiply by 0.105 for $PM_{2.5}$ USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1, 11.9-3

50 s = Silt content (%) (from soil boring B-4)
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
4.30 lb/hr of PM_{10}
1.42 lb/hr of $PM_{2.5}$

Equipment	Quantity	Hours/Day	Watering Control Efficiency	PM10 Emissions (ton/yr)	PM2.5 Emissions (ton/yr)
Dozer	50	6	67%	4.68	1.55
			Total	**4.68**	**1.55**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Scraper	1,691,750	67%	0.0179	0.0027
Loader	1,522,575	67%	0.0161	0.0024
Backhoe	169,175	67%	0.0018	0.0003
	3,383,500	**Total**	**0.0357**	**0.0054**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
assume scraper handles 50% of dirt, loader 45%, and backhoe 5%

18,619 yd^3/day 21,971 ton/day 2360 density of soil (lb/yd^3)
2,867,373 yd^3 3,383,500 tons (USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
354.75 acres = 2,867,373 cubic yds, assume depth of soils moved is 1.67 yd
(assume 75% of entire site disturbed in 12 month period)

Cover Storage Pile

SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	40	0.25	365	67%	0.48	0.099

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
4 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Concrete Pumper Truck	6	2	0.75	198.0	30	10	0.66	67%	0.022	0.005
Dump Truck	32	8	0.75	4224.0	15	10	0.41	67%	0.285	0.060
Service Truck - 1 ton	0			0.0	15	10	0.41	67%	0.000	0.000
Pile Driver Truck	12	2	0.1	52.8	15	10	0.41	67%	0.004	0.001
Truck - Fuel/Lube	0			0.0	15	10	0.41	67%	0.000	0.000
Tractor Truck 5th Wheel	0			0.0	11	10	0.33	67%	0.000	0.000
Trucks - Pickup 3/4 ton	60	10	0.5	6600.0	3	4	0.08	67%	0.091	0.019
Trucks - 3 ton	15	2	0.5	330.0	11	10	0.33	67%	0.018	0.004
Truck - Water	28	4	1	2464.0	25	10	0.59	67%	0.238	0.050
Air Compressor 185 CFM	0			0.0	0.5	2	0.02	67%	0.000	0.000
Air Compressor 750 CFM	16	1	0.01	3.5	0.5	2	0.02	67%	0.000	0.000
Articulating Boom Platform	0			0.0	5	10	0.19	67%	0.000	0.000
Bulldozer D10R	24	1	0.1	52.8	35	2	0.33	67%	0.003	0.001
Bulldozer D4C	26	1	0.1	57.2	15	2	0.18	67%	0.002	0.000
Concrete Trowel Machine	8	1	0.25	44.0	15	8	0.37	67%	0.003	0.001
Concrete Vibrators	0			0.0	0.25	0	0.00	67%	0.000	0.000
Cranes - Mobile 35 ton	15	1	0.1	33.0	25	12	0.64	67%	0.003	0.001
Cranes - Mobile 45 ton	0			0.0	35	2	0.33	67%	0.000	0.000
Crane - Mobile 65 ton	0			0.0	45	2	0.39	67%	0.000	0.000
Cranes 100 / 150 ton cap	2	0	0	0.0	50	12	1.04	67%	0.000	0.000
Diesel Powered Welder	8	0	0	0.0	0.5	2	0.02	67%	0.000	0.000
Backhoe/loader	40	4	0.25	880.0	11	4	0.21	67%	0.030	0.006
Earth Scraper	24	1	0.1	52.8	40	4	0.51	67%	0.004	0.001
Loader	24	2	0.5	528.0	25	4	0.37	67%	0.032	0.007
Motor Grader	14	2	0.5	308.0	20	6	0.39	67%	0.020	0.004
Excavator - Trencher	0			0.0	17	4	0.28	67%	0.000	0.000
Fired Heaters	24	0	0	0.0	0.25	0	0.00	67%	0.000	0.000
Forklift	7	5	0.5	385.0	10	4	0.19	67%	0.012	0.003
Fusion Welder	0			0.0	0.25	2	0.01	67%	0.000	0.000
Heavy Haul / Cranes	0			0.0	75	2	0.56	67%	0.000	0.000
Light Plants	18	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Portable Compaction Roller	19	0	0	0.0	3	3	0.07	67%	0.000	0.000
Portable Compaction - Plate	15	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Compaction - Ram	0			0.0	0.25	0	0.00	67%	0.000	0.000
Pumps	35	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Power Generators	19	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Truck Crane - Greater than 200 ton	1	1	0.1	2.2	50	12	1.04	67%	0.000	0.000
Truck Crane - Greater than 300 ton	0			0.0	60	12	1.18	67%	0.000	0.000
Vibratory Roller 20 ton	27	2	0.25	297.0	20	3	0.27	67%	0.013	0.003
worker personal vehicles	2028	1	0.5	22304.6	3	4	0.08	67%	0.309	0.065
								Total	**1.090**	**0.231**

worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, total for months 1-12 divided by 1.3 employees per vehicle

Assumed maximum travel speed is 4 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
except for worker vehicles - parking area will be graveled and main road onsite will be paved
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.

Total Annual Fugitive Dust from Onsite Equipment - Months 1 - 12

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Grading	0.3498	0.0283
Bulldozing	4.6805	1.5505
Dirt Piling	0.0357	0.0054
Storage Piles	0.4763	0.0991
Travel on Unpaved Roads	1.0898	0.2310
TOTAL	**6.63**	**1.91**

Annual Fugitive Dust Emissions

Maximum annual fugitive dust activity occurs in months 17-28.

7 months of soil disturbance
10 total construction hours per work day
22 construction days per month
60% average load factor for equipment listed (CEQA)

Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for PM_{10}
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of PM_{10}/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

Equipment	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Scraper	1,691,750	67%	0.018	0.003
Loader	1,522,575	67%	0.016	0.002
Backhoe	169,175	67%	0.002	0.000
	3,383,500	**Total**	**0.036**	**0.005**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
assume scraper handles 50% of dirt, loader 45%, and backhoe 5%

18,619 yd^3/day 21,971 ton/day 2360 density of soil (lb/yd^3)
2,867,373 yd^3 3,383,500 tons (USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
354.75 acres = 2,867,373 cubic yds, assume depth of soils moved is 1.67 yd
(assume 75% of entire site in 12 month period)

Cover Storage Pile

SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM10 = 0.5
0.791 lb/acre/day

wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	40	0.25	365	67%	0.48	0.099

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
4 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Concrete Pumper Truck	6	2	0.75	198.0	30	10	0.66	67%	0.022	0.005
Dump Truck	0			0.0	15	10	0.41	67%	0.000	0.000
Service Truck - 1 ton	0			0.0	15	10	0.41	67%	0.000	0.000
Pile Driver Truck	0			0.0	15	10	0.41	67%	0.000	0.000
Truck - Fuel/Lube	0			0.0	15	10	0.41	67%	0.000	0.000
Tractor Truck 5th Wheel	0			0.0	11	10	0.33	67%	0.000	0.000
Trucks - Pickup 3/4 ton	60	10	0.5	6600.0	3	4	0.08	67%	0.091	0.019
Trucks - 3 ton	24	2	0.5	528.0	11	10	0.33	67%	0.029	0.006
Truck - Water	12	4	1	1056.0	25	10	0.59	67%	0.102	0.022
Air Compressor 185 CFM	0			0.0	0.5	2	0.02	67%	0.000	0.000
Air Compressor 750 CFM	48	1	0.01	10.6	0.5	2	0.02	67%	0.000	0.000
Articulating Boom Platform	0			0.0	5	10	0.19	67%	0.000	0.000
Bulldozer D10R	0			0.0	35	2	0.33	67%	0.000	0.000
Bulldozer D4C	0			0.0	15	2	0.18	67%	0.000	0.000
Concrete Trowel Machine	12	1	0.25	66.0	15	8	0.37	67%	0.004	0.001
Concrete Vibrators	0			0.0	0.25	0	0.00	67%	0.000	0.000
Cranes - Mobile 35 ton	80	1	0.1	176.0	25	12	0.64	67%	0.019	0.004
Cranes - Mobile 45 ton	0			0.0	35	2	0.33	67%	0.000	0.000
Crane - Mobile 65 ton	70	1	0.1	154.0	45	2	0.39	67%	0.010	0.002
Cranes 100 / 150 ton cap	48	0	0	0.0	50	12	1.04	67%	0.000	0.000
Diesel Powered Welder	41	0	0	0.0	0.5	2	0.02	67%	0.000	0.000
Backhoe/loader	6	4	0.25	132.0	11	4	0.21	67%	0.005	0.001
Earth Scraper	0			0.0	40	4	0.51	67%	0.000	0.000
Loader	0			0.0	25	4	0.37	67%	0.000	0.000
Motor Grader	0			0.0	20	6	0.39	67%	0.000	0.000
Excavator - Trencher	0			0.0	17	4	0.28	67%	0.000	0.000
Fired Heaters	53	0	0	0.0	0.25	0	0.00	67%	0.000	0.000
Forklift	36	5	0.5	1980.0	10	4	0.19	67%	0.064	0.013
Fusion Welder	0			0.0	0.25	2	0.01	67%	0.000	0.000
Heavy Haul / Cranes	32	0	0	0.0	75	2	0.56	67%	0.000	0.000
Light Plants	84	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Portable Compaction Roller	10	0	0	0.0	3	3	0.07	67%	0.000	0.000
Portable Compaction - Plate	18	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Compaction - Ram	0			0.0	0.25	0	0.00	67%	0.000	0.000
Pumps	24	0	0	0.0	0.1	0	0.00	67%	0.000	0.000
Portable Power Generators	60	0	0	0.0	0.5	4	0.02	67%	0.000	0.000
Truck Crane - Greater than 200 ton	42	1	0.1	92.4	50	12	1.04	67%	0.016	0.003
Truck Crane - Greater than 300 ton	27	0	0	0.0	60	12	1.18	67%	0.000	0.000
Vibratory Roller 20 ton	0			0.0	20	3	0.27	67%	0.000	0.000
worker personal vehicles	10919	1	0.5	120111.5	3	4	0.08	67%	1.662	0.352
								Total	**2.023**	**0.429**

worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, total for months 17-28 divided by 1.3 employees per vehicle

Assumed maximum travel speed is 4 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Construtions.")
except for worker vehicles - parking area will be graveled and main road onsite will be paved
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.

Total Annual Fugitive Dust from Onsite Equipment - Months 17 - 28

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Dirt Piling	0.0357	0.0054
Storage Piles	0.4763	0.0991
Travel on Unpaved Roads	2.0226	0.4288
TOTAL	**2.53**	**0.53**

Hydrogen Energy California, Kern County Power Project
Unmitigated Annual Exhaust Emissions For Offsite Construction Equipment
5/12/2010

	CO		CO_2		CH_4		N_2O		NO_x		PM_{10}		$PM_{2.5}$		SO_x		ROG[1]	
Month	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)	Monthly Emissions (tons)	12-Month Total (tons)
1	0.29	NA	46.40	NA	0.01	NA	0.0009	NA	0.49	NA	0.038	NA	0.035	NA	0.0005	NA	0.11	NA
2	0.29	NA	46.40	NA	0.01	NA	0.0009	NA	0.49	NA	0.038	NA	0.035	NA	0.0005	NA	0.11	NA
3	0.32	NA	48.85	NA	0.01	NA	0.0010	NA	0.51	NA	0.041	NA	0.037	NA	0.0005	NA	0.12	NA
4	0.32	NA	48.85	NA	0.01	NA	0.000968	NA	0.51	NA	0.041	NA	0.037	NA	0.0005	NA	0.120	NA
5	0.32	NA	48.85	NA	0.01	NA	0.0010	NA	0.51	NA	0.041	NA	0.037	NA	0.0005	NA	0.12	NA
6	0.41	NA	68.26	NA	0.01	NA	0.0015	NA	0.72	NA	0.051	NA	0.046	NA	0.0007	NA	0.14	NA
7	0.41	NA	68.26	NA	0.01	NA	0.0015	NA	0.72	NA	0.051	NA	0.046	NA	0.0007	NA	0.14	NA
8	0.41	NA	68.26	NA	0.01	NA	0.0015	NA	0.72	NA	0.051	NA	0.046	NA	0.0007	NA	0.14	NA
9	0.47	NA	75.06	NA	0.01	NA	0.0016	NA	0.80	NA	0.058	NA	0.053	NA	0.0008	NA	0.16	NA
10 max short term	0.47	NA	75.06	NA	0.01	NA	0.001585	NA	0.80	NA	0.058	NA	0.053	NA	0.0008	NA	0.164	NA
11	0.38	NA	55.66	NA	0.01	NA	0.001092	NA	0.59	NA	0.048	NA	0.044	NA	0.0006	NA	0.140	NA
12 max 12 month period	0.38	4.47	55.66	705.58	0.01	0.0991	0.001092	0.0145	0.59	7.45	0.048	0.563	0.044	0.514	0.0006	0.0076	0.140	1.610
13	0.00	4.18	0.00	659.17	0.00	0.0934	0.000000	0.0135	0.00	6.96	0.000	0.526	0.000	0.480	0.0000	0.0071	0.000	1.503
14	0.00	3.89	0.00	612.77	0.00	0.0877	0.00	0.01264	0.00	6.47	0.00	0.488	0.00	0.445	0.00	0.0066	0.00	1.397
15	0.00	3.56	0.00	563.91	0.00	0.0807	0.00	0.01167	0.00	5.96	0.00	0.447	0.00	0.408	0.00	0.0061	0.00	1.277
16	0.00	3.24	0.00	515.06	0.00	0.0737	0.00	0.0107	0.00	5.44	0.00	0.406	0.00	0.371	0.00	0.0056	0.00	1.157
17	0.00	2.92	0.00	466.20	0.00	0.067	0.00	0.0097	0.00	4.93	0.00	0.365	0.00	0.333	0.00	0.005	0.00	1.037
18	0.00	2.51	0.00	397.95	0.00	0.058	0.00	0.0083	0.00	4.21	0.00	0.314	0.00	0.287	0.00	0.004	0.00	0.894
19	0.00	2.10	0.00	329.69	0.00	0.049	0.00	0.0068	0.00	3.49	0.00	0.263	0.00	0.241	0.00	0.004	0.00	0.751
20	0.00	1.69	0.00	261.43	0.00	0.039	0.00	0.0054	0.00	2.77	0.00	0.213	0.00	0.194	0.00	0.003	0.00	0.607
21	0.00	1.23	0.00	186.38	0.00	0.029	0.00	0.0038	0.00	1.97	0.00	0.155	0.00	0.141	0.00	0.002	0.00	0.444
22	0.00	0.76	0.00	111.32	0.00	0.018	0.00	0.0022	0.00	1.18	0.00	0.097	0.00	0.088	0.00	0.001	0.00	0.280
23	0.00	0.38	0.00	55.66	0.00	0.009	0.00	0.0011	0.00	0.59	0.00	0.048	0.00	0.044	0.00	0.001	0.00	0.140
24	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
25	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
26	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
27	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
28	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
29	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
30	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
31	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
32	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
33	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
34	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
35	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
36	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
37	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
38	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
39	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
40	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
41	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
42	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
43	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
44	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.0000	0.00	0.00	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Maximum (100 % load)	**0.47**	**4.47** #	**75.06**	**705.58** #	**0.01**	**0.0991** #	**0.001585**	**0.0145** #	**0.80**	**7.45** #	**0.058**	**0.563** #	**0.053**	**0.514** #	**0.0008**	**0.0076** #	**0.164**	**1.610**
Average (66 % load)	**0.31**	**2.95** #	**49.54**	**465.68** #	**0.01**	**0.07** #	**0.0010**	**0.0095** #	**0.53**	**4.91** #	**0.038**	**0.372** #	**0.035**	**0.340** #	**0.0005**	**0.01** #	**0.11**	**1.06**

Note:
[1] Assuming ROGs are equivalent to VOCs
- Assuming 75% operational average load

Annual Off-Site Linears Fugitive Dust Emissions — Emissions Summary

Hydrogen Energy, Inc *5/12/2010*
HECA Project

Annual Fugitive Dust Emissions for Offsite Linears
Maximum annual fugitive dust activity occurs in months 1-12.

12 months of soil disturbance
10 total construction hours per work day
22 construction days per month

Dirt Piling or Material Handling
$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$ PM_{10} Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

12 G = Mean Wind speed (mph) default
15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)
0.00021 lb of PM_{10}/ ton of material

Equipment	Quantity/ year	Hours/ Day	Annual Material Handled (ton)	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Backhoe	12	10	1,102,262	67%	0.0379	0.0079
				Total	**0.0379**	**0.0079**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM10 Emissions - Constrution.")

3538 yd^3/day 4175 ton/day
934,120 yd^3 1,102,262 tons 2360 density of soil (lb/yd^3)
(USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
193 acres = 934,120 cubic yds, assume depth of soils moved is 1 yd

Storage Piles
SCAQMD Table A9-9-E
$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from Geotechnical Investigaion, AFC Appendix P)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5 J = Fraction of TSP that is PM_{10} = 0.5
0.791 lb/acre/day

wind speed percentage based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Storage Piles	8	0.25	365	67%	0.10	0.020

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")
pile size and number are assumed
Days per year accounts for weekend days also, not just work days

Travel on unpaved road
$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D
Emission factor for vehicle travel on unpaved roads (lb/VMT)

4 G = Surface silt loading (%) (value for gravel road)
5 H = Mean vehicle speed (mph)
value listed in table I = Mean number of wheels on vehicle
value listed in table J = Mean vehicle weight (ton)
37 K = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)

Vehicle Type	Quantity per year (units*mo./yr)	Round Trips /Day/ Unit	Round Trip Distance on Dirt Surface (mile)	Annual VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM_{10} EF (lbs/VMT)	Watering Control Efficiency	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
ON ROAD										
Dump Truck	12	4	0.25	264.0	17	10	0.56	67%	0.0243	0.0052
Service Truck (MHD-DSL)	0	1	0.125	0.0	4	6	0.16	67%	0.0000	0.0000
Pipe Haul Truck and Trailer (HHDT-DSL	12			0.0	15	10	0.51	67%	0.0000	0.0000
Truck (Pickup 3/4 Ton) - MHD-DSL	17	2	0.25	187.0	1	4	0.05	67%	0.0015	0.0003
Truck - water	12	4	0.25	264.0	25	10	0.73	67%	0.0319	0.0068
OFF ROAD										
Air Compressor	10					4	0.00	67%	0.0000	0.0000
Bore Machine (Hydraulic)	5					10	0.00	67%	0.0000	0.0000
Crane	5					10	0.00	67%	0.0000	0.0000
Backhoe	12					2	0.00	67%	0.0000	0.0000
Excavator	12	1	0.25	66.0	17	4	0.35	67%	0.0038	0.0008
Forklift	4	4	0.25	88.0	10	4	0.24	67%	0.0035	0.0007
Welding Generator	4					3	0.00	67%	0.0000	0.0000
Roller	12	4	0.25	264.0	20	3	0.34	67%	0.0149	0.0032
Pipe Bending Machine	12						0.00	67%	0.0000	0.0000
worker personal vehicles	2028	1	0.125	5576.2	3	4	0.10	67%	0.0965	0.0204
								Total	**0.1764**	**0.0374**

offsite worker personal vehicle data from Table 2-25, Estimated Monthly Construction Workforce from AFC, total for months 1-12 divided by 1.3 employees per vehicle

Assumed maximum travel speed is 5 mph
Equipment weight from SCAQMD Table A9-9-D-3 and various websites
Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for PM_{10} Emissions - Constrution.")
except for worker vehicles - parking area will be graveled and main road onsite will be paved
$PM_{2.5}$ emission factors from updated CEIDARS List with $PM_{2.5}$ fractions.
$PM_{2.5}$ numbers obtained by multiplying the PM_{10} values by fraction in CEIDARS list for appropriate fugitive dust sources.
Water trucks operate at least 4 times per day.
Truck quantity based on monthly maximums

Total Annual Fugitive Dust from Offsite Linears Construction

	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (tons/yr)
Dirt Piling or Material Handling	0.0379	0.0079
Storage Piles	0.0953	0.0198
Travel on unpaved road	0.1764	0.0374
TOTAL	**0.3096**	**0.0651**

Summary of On Site Operations Truck Emissions - HECA — Emissions Summary

Hydrogen Energy International LLC
HECA Project

Transportation Information			Notes
- Onsite Vehicle =	20	trucks	- Information Provided By Applicant
- Vehicle year=	2010		- Information Provided By Applicant
- Maximum annual mileage =	10,000	miles/truck-year	- All routine vehicular traffic is anticipated to travel exclusively on paved roads
			- Assumed 15 mph average speed within HECA facility

Calculations for Trucks Operation Modeling

	Onsite O&M Trucks (@ 15 mph)
Mileage	
1-hr	1
3-hr	3
8-hr	9
24-hr	27
Annual average trucks or loads	10000

Emission Factor based on equation from AP-42, Chapter 13 (Paved Roads)

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$$

E = particulate emission factor
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading
W = average weight (tons) of the vehicles traveling the road
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

Parameter	Value	Unit	
k =	0.016	lb/VMT	AP 42, Table 13.2-1.1: default k value for PM_{10}
C =	0.00047	lb/VMT	AP 42, Table 13.2-1.2: default C value for PM_{10}
sL=	0.031	g/m^2	Default value from URBEMIS 9.2 for Kern County
W =	2.65	ton	Default value from URBEMIS 9.2 for Kern County
E =	4.1E-04	lb/VMT	Calculated using AP-42 factors
	0.19	g/VMT	Calculated using AP-42 factors

EMFAC2007 Emission Factors (g/mi)

	AERMOD		HARP
Pollutant	Gas LHDT1	Diesel LHDT2	Diesel LHDT2
CO	0.229	0.92	NA
NOx	0.064	0.672	NA
SOx	0.011	0.005	NA
PM10 *	0.23	0.24	0.07
PM2.5	0.022	0.03	NA
ROG	0.014	0.085	NA

** PM10 includes entrained road dust factor for paved roads obtained from AP-42 Ch. 13, using defaults from URBEMIS 9.2*
However, the HARP PM10 value is for exhaust emissions only.
AERMOD input assumed 2015 scenario. HARP input assumed 2040 scenario (70 years average)

1-hr Emission Rates for AERMOD (g/s)

	AERMOD		HARP
Pollutant	Gas LHDT1	Diesel LHDT2	Diesel LHDT2
CO	7.26E-05	2.92E-04	NA
NOx	2.03E-05	2.13E-04	NA
SOx	3.49E-06	1.59E-06	NA
PM10	7.21E-05	7.49E-05	2.1E-05
PM2.5	6.98E-06	9.51E-06	NA

3-hr Emission Rates for AERMOD (g/s)

	AERMOD		HARP
Pollutant	Gas LHDT1	Diesel LHDT2	Diesel LHDT2
CO	7.26E-05	2.92E-04	NA
NOx	2.03E-05	2.13E-04	NA
SOx	3.49E-06	1.59E-06	NA
PM10	7.21E-05	7.49E-05	2.1E-05
PM2.5	6.98E-06	9.51E-06	NA

8-hour Emission Rates for AERMOD (g/s)

	AERMOD		HARP
Pollutant	Gas LHDT1	Diesel LHDT2	Diesel LHDT2
CO	7.26E-05	2.92E-04	NA
NOx	2.03E-05	2.13E-04	NA
SOx	3.49E-06	1.59E-06	NA
PM10	7.21E-05	7.49E-05	2.1E-05
PM2.5	6.98E-06	9.51E-06	NA

24-hour Emission Rates for AERMOD (g/s)

	AERMOD		HARP
Pollutant	Gas LHDT1	Diesel LHDT2	Diesel LHDT2
CO	7.26E-05	2.92E-04	NA
NOx	2.03E-05	2.13E-04	NA
SOx	3.49E-06	1.59E-06	NA
PM10	7.21E-05	7.49E-05	2.1E-05
PM2.5	6.98E-06	9.51E-06	NA

Annual Emission Rates for AERMOD (g/s)

	AERMOD		HARP
Pollutant	Gas LHDT1	Diesel LHDT2	Diesel LHDT2
CO	7.26E-05	2.92E-04	NA
NOx	2.03E-05	2.13E-04	NA
SOx	3.49E-06	1.59E-06	NA
PM10	7.21E-05	7.49E-05	2.1E-05
PM2.5	6.98E-06	9.51E-06	NA
ROG	4.44E-06	2.70E-05	NA

The HARP PM10 emission rates do not include road-entrained dust or brake and tire wear.

ATTACHMENT 57-1

Summary of Truck Emissions - HECA — Emissions Summary

Hydrogen Energy International LLC
HECA Project

Calculations for Trucks Operation Modeling

Data Supplied By Client				
Parameter	**Coke and Coal Trucks (@ 10 mph)**		**Onsite Gasifier Solids Handling (@ 5 mph)**	
	Running Emissions	**Idling Emissions**	**Running Emissions**	**Idling Emissions**
Distance Traveled (mi)*	1		0.5	
Per Truck Idle Time (hr)		0.117		0.083
Maximum number of trucks or loads:				
1-hr	18	18	2	2
3-hr	54	54	7	7
8-hr	144	144	13	13
24-hr	180	180	38	37.5
Annual average trucks or loads	35,500	35500	2,900	2900

* The distance traveled is equivalent to

Emission Factor based on equation from AP-42, Chapter 13 (Paved Roads)

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$$

E = particulate emission factor
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading
W = average weight (tons) of the vehicles traveling the road
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

Parameter	**Value**	**Unit**	
k =	0.016	lb/VMT	AP 42, Table 13.2-1.1: default k value for PM_{10}
C =	0.00047	lb/VMT	AP 42, Table 13.2-1.2: default C value for PM_{10}
sL=	0.031	g/m^2	Default value from URBEMIS 9.2 for Kern County
W =	2.65	ton	Default value from URBEMIS 9.2 for Kern County
E =	4.1E-04	lb/VMT	Calculated using AP-42 factors
	0.19	g/VMT	Calculated using AP-42 factors

ATTACHMENT 57-1

EMFAC2007 Emission Factors (g/mi or g/idle-hour)

Pollutant	Coke and Coal Trucks (@ 10 mph)		Onsite Gasifier Solids Handling (@ 5 mph)	
	Running Emissions	Idling Emissions	Running Emissions	Idling Emissions
CO	3.028	43.689	5.052	43.689
NOx	5.427	122.647	7.237	122.647
SOx	0.03	0.062	0.04	0.062
PM10 *	0.34	0.114	0.35	0.114
PM2.5	0.101	0.104	0.109	0.104
ROG	1.388	7.744	2.546	7.744

** PM10 includes entrained road dust factor for paved roads obtained from AP-42 Ch. 13, using defaults from URBEMIS 9.2*

1-hr Emission Rates for AERMOD (g/s)

Pollutant	Coke and Coal Trucks (@ 10 mph)		Onsite Gasifier Solids Handling (@ 5 mph)	
	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)
CO	0.015	0.025	0.001	0.002
NOx	0.027	0.072	0.002	0.006
SOx	1.5E-04	3.6E-05	1.0E-05	2.9E-06
PM10	0.002	0.000	0.000	5.3E-06
PM2.5	0.001	0.000	3.03E-05	4.8E-06

3-hr Emission Rates for AERMOD (g/s)

Pollutant	Coke and Coal Trucks (@ 10 mph)		Onsite Gasifier Solids Handling (@ 5 mph)	
	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)
CO	0.015	0.025	0.002	0.002
NOx	0.027	0.072	0.002	0.007
SOx	1.5E-04	3.6E-05	1.2E-05	3.3E-06
PM10	0.002	0.000	0.000	6.2E-06
PM2.5	0.001	0.000	3.53E-05	5.6E-06

ATTACHMENT 57-1

8-hour Emission Rates for AERMOD (g/s)

	Coke and Coal Trucks (@ 10 mph)		Onsite Gasifier Solids Handling (@ 5 mph)	
Pollutant	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)
CO	0.015	0.025	0.001	0.002
NOx	0.027	0.072	0.002	0.005
SOx	1.5E-04	3.6E-05	8.4E-06	2.3E-06
PM10	0.002	0.000	7.8E-05	4.3E-06
PM2.5	0.001	0.000	2.5E-05	3.9E-06

24-hour Emission Rates for AERMOD (g/s)

	Coke and Coal Trucks (@ 10 mph)		Onsite Gasifier Solids Handling (@ 5 mph)	
Pollutant	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)
CO	0.006	0.011	0.001	0.002
NOx	0.011	0.030	0.002	0.004
SOx	6.3E-05	1.5E-05	8.0E-06	2.2E-06
PM10	0.001	2.8E-05	7.5E-05	4.1E-06
PM2.5	0.000	2.5E-05	2.4E-05	3.8E-06

Annual Emission Rates for AERMOD (g/s)

	Coke and Coal Trucks (@ 10 mph)		Onsite Gasifier Solids Handling (@ 5 mph)	
Pollutant	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)
CO	0.003	0.006	0.000	0.000
NOx	0.006	0.016	0.000	0.001
SOx	3.4E-05	8.1E-06	1.7E-06	4.8E-07
PM10	0.000	1.5E-05	1.6E-05	8.7E-07
PM2.5	0.000	1.4E-05	5.0E-06	8.0E-07
ROG	0.002	1.0E-03	1.2E-04	5.9E-05